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COMPRESSED AIR MAGAZINE

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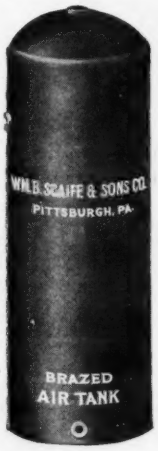

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COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

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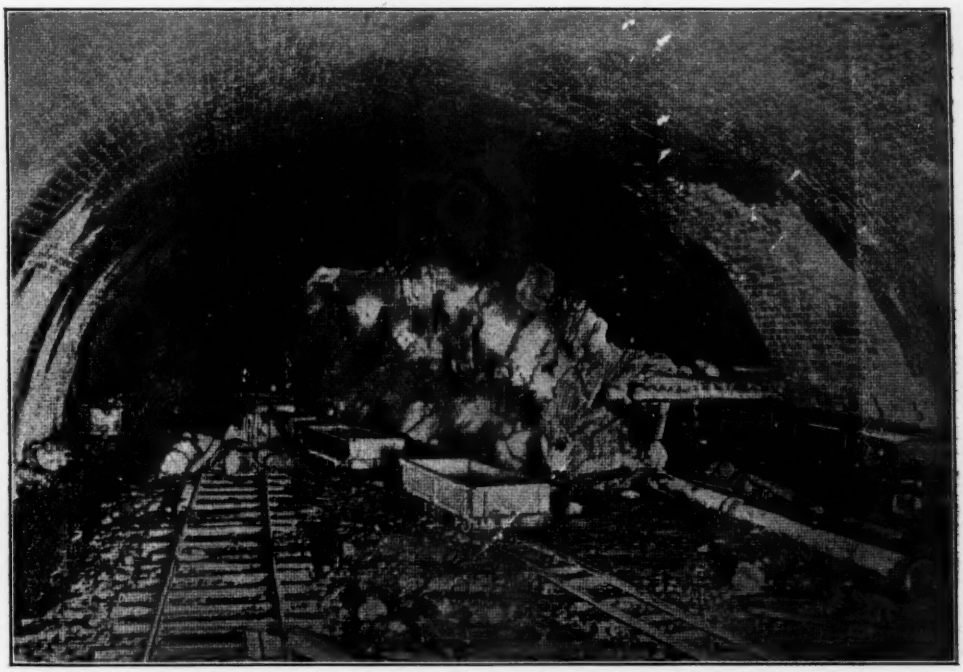


CUTTING OUT THE CORE OF THE BIG TUNNEL.

LATEST AND GREATEST WORLD TUNNEL

The tunnel interior here shown tells its own story most impressively. The work shown is in France where while the greatest war of the ages is taxing the nation's resources to the uttermost the obligation of providing for its future life and growth is still imperative. More than a dozen years ago the plans became operative for a canal to connect the important seaport of Marseilles with the river Rhone and the existing system of interior waterways, and the work has been carried on notwithstanding the exigent war conditions.

The total length of the canal is 51 miles and its water section is 82 feet wide and 10 feet deep, with wide tow-paths on each side. The most exacting engineering feature is the tunnel, the necessity of building which long held back the entire enterprise. This tunnel which is now within sight of completion is in more than one particular the greatest yet undertaken in the

world. It is 4½ miles long, which makes it the longest in France, but its sectional area is about ten times that of an ordinary railroad tunnel while the rock to be removed is some 50 per cent. more than that taken from the two Simplan tunnels and very nearly double that from the St. Gothard.

The tunnel section may be conveniently described as a horizontal rectangle upon which is superimposed a circular segment, giving an extreme width of 79 feet, a height of 50 ft. and a section of 3,250 sq. ft. The tunnel construction, which was through sound, hard rock, requiring little timbering, was carried on from three arch headings of about 100 sq. ft. area which were then opened into each other, leaving a large central section to be removed later.

The lining of the tunnel is of masonry backed on concrete, which is made of a special lime and not from the usual Portland cement. The retention of the central mass until the last made it easy and profitable to do all the lining without the erection of high and expensive scaffolding. The half tone shows the lining completed and the removal of the core in progress, this operation being similar to any out of door rock work. It will be seen that the latest type of hand-held, one-man drills are employed. The trains for removing the spoil are drawn by compressed air locomotives in the headings and by steam in the open section. The "holing through" of the tunnel was celebrated on May 6 of last year and was spoken of in the August issue of Compressed Air Magazine. It is understood that two or three years will still be required for the completion of the entire work.

An indication of the widespread interest in engineering circles as to our future commercial and engineering relations with South American countries is given by the fact that 180 out of 231 students entering Stevens Institute of Technology this fall have elected to study Spanish instead of French or German. This is a remarkable increase in proportion over other years at Stevens in favor of Spanish. Every student entering Stevens is required to study one foreign language during the first two years of his course, and is allowed to choose either advanced French or German or beginner's Spanish.

FIG. I. ON CROW NEST MOUNTAIN.

ROCK WORK ON STORM KING HIGHWAY

BY H. L. HICKS

Construction work is being pushed on the Storm King Road, the final link in the New York State Highway between New York and Albany. It extends a distance of 4¼ miles between West Point and Cornwall, N. Y. For practically the entire distance the road is a side hill cut around Crow Nest and Storm King Mountains. It directly overlooks the Hudson River and reaches at its highest point an elevation of 400 ft. above sea level.

The mountain sides are very steep and inaccessible and road building presents many difficulties. The excavation work required totals 60,000 cu. yd. of rock and 80,000 cu. yd. of earth and boulders. The rock is a bastard granite and the boulders vary in size up to 250 cu. yd. There are seven gangs at work in four different places, making the cut and building the retaining wall. This is from 10 to 50 ft. in height, from 3 to 8 ft. being laid in mortar and the balance dry masonry, completed by a rustic stone parapet. Stones for the wall are placed by four hoists and two cranes. The balance of the handling and hauling is done by hand and, at one working, by mules.

JACKHAMERS

Drilling for excavation and for anchoring the retaining walls is done by Jackhamers, of which there are 12 in use. These hand drills are giving a good account of themselves al-

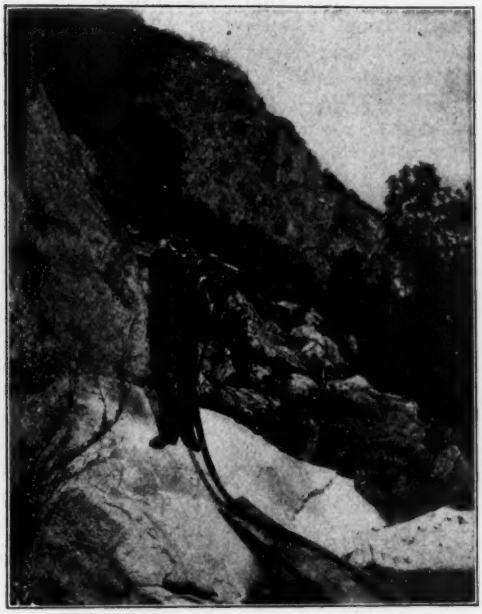


FIG. 2. AWKWARD JACKHAMER DRILLING.

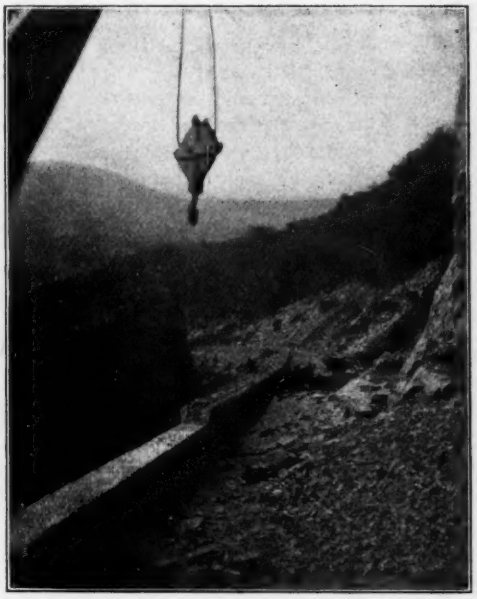


FIG. 3. ROUGH GRADED ROADWAY.

though the duty is a severe one. Much of the work is done in places and at angles which make it impossible for the drill runner to properly hold his machine. In fact, it is quite common for the drill to support the man instead of the man holding the drill. In drilling the cliff at Storm King, where the cut rose a sheer 150 ft. above the road bed, the workmen drilled while suspended in a harness of heavy canvas bands. Unfortunately for the contractor this portion of the work was brought to a standstill at a time when the Jackhamer operators had been working in mid-air long enough to have become accustomed to it and to have reached their maximum efficiency. A stone company, whose unused crusher plant, lying at the foot of the cliff was damaged by falling rock, obtained an injunction indefinitely halting work at this place.

Cross bits are used at all workings. Sharpening is done both by hand and by a Leyner sharpener. The latter is mounted on the edge of the cliff with scant protection from the elements. It is used for shanking as well as sharpening. Air for operating the Jackhamers and hoists at all workings is piped from a plant at the Cornwall end of the contract. This air compressing plant, a 1,400 cu. ft. Imperial short belt, electric motor driven machine, was purchased, as it stands from the Oscar Daniels Co., who had recently completed the Moodna Siphon of the Catskill Aqueduct. The air line follows the track of the West Shore R. R. at the foot of the mountains. There is 500 ft.

FIG. 4. LEYNER DRILL SHARPENER ON EDGE OF CLIFF.

of 6-in., 300 ft. of 4-in. piping, the balance being of 2-in. diameter. All branches from this main air line to the working places are of 2-in. pipe.

Considerable trouble is experienced from rock falling on the railroad tracks. The contractor maintains a locomotive crane on a siding at the foot of each mountain, although the rock that comes down is usually small enough to be removed by hand. At the time the writer's visit a flying fragment, striking a telegraph pole, broke it in half. At other times rails have been broken.

The John L. Hayes Construction Co. of Cornwall, N. Y., is building this road under the personal direction of Mr. John L. Hayes. Mr. A. C. Perkins is superintendent, assisted by Mr. J. J. O'Neill.

THE ENGINEER SAVES THE MACARONI

In the following interesting narrative which we reproduce from a recent issue of *Saturday Evening Post* it is to be noted that while the chemical engineer is spoken of all through the article there was really no chemistry involved in the solution, although it may have entered into the preliminary investigations. Success came with the proper adjustment of the temperature and humidity of the air and its proper circulation.

Two young Italians, who had worked in a small but successful macaroni factory in the East, started an enterprise of this kind in a Western city. Their drier was an exact reproduction of the one in the plant where they had worked. The product of their little factory was entirely acceptable to their market; and, as both these young Neapolitans were hustlers and were well located, their business grew in the course of a few years to a point where they faced the necessity of providing a much larger output. Consequently they built an addition to their factory and installed a drier of large capacity, calculated to take care of all the expansion they could reasonably expect in the next few years. The new drier was modeled after the one that had given them such satisfactory service from the very beginning of their business.

Probably one of the greatest strains to which the true Neapolitan temperament was ever subjected was exerted when the two partners made the discovery that the product of their new drier was so far inferior to that of the old one as to spell failure for them unless the trouble could be corrected. Instead of being hard and brittle, and breaking with a long fracture, the tubes of macaroni from the new drier were green and semi-elastic, with the result that they were both unacceptable for immediate use and were prone to mold and spoil.

One alteration after another was made in the equipment of the new drier, but without producing any marked improvement in the product. This period of hit-or-miss experiment extended over several months, the proprietors growing more desperate with every passing week.

Finally they took one of their most intelligent customers into their confidence and he advised them to consult a leading chemical engineer, whose laboratories were located in Chicago. He warned them that probably the fee would not be small and that satisfactory results could not be guaranteed. As it was clear to them that they were facing financial ruin, they decided to accept the alternative, take the chances, and see what laboratory science could do for a macaroni drier and its product.

The chemical engineer first satisfied himself that the failure of the product was not due to any defect in the materials used—which were found to be of the highest quality—but that the fault must lie in the curing alone.

A CLIMATE TO ORDER

He then defined his problem by saying that it was up to him to create, inside of that drier, an ideal Italian climate which could be relied upon to remain the same day after day. This he finally succeeded in doing, securing a combination of heat, humidity and air velocity that was practically "foolproof," and that cured the macaroni as perfectly as if it was dried in the sunshine and breezes of Italy.

Naturally any attempt to convince these two Neapolitans that industrial chemistry is either impractical or too expensive an aid for the small manufacturer would be so much wasted breath. They look upon the laboratory of the consulting chemist to whom they appealed for help very much as a rescued seaman might look upon the life-saving station whose crew had saved him when he seemed ready to sink.

A man in Canada traveled from Dundas to Niagara Falls, 125 miles, on four gallons of gasoline—31 miles per gallon—in a Gray-Dort 4-cyl. car.

AIR DELIVERY FACTORS OF BLOWING ENGINES

BY W. TRINKS

Whenever the air delivery as determined by the indicator card is compared to the air as computed from the chemical reactions in the blast furnace, or to the quantity found from a careful test, a discrepancy is discovered. The actual air delivery is always smaller than that computed from the indicator card. The reasons for this difference are heat interchange, and leakage. During compression, air heats the walls of the air tub. During suction, the walls heat the incoming air to an unknown temperature. The air tub is, therefore, filled to an extent indicated by the card, but with air of smaller density, the unknown reduction of density corresponding to the unknown rise of temperature. However, the change of density varies within certain limits which are well known from tests, and is not responsible for the great reduction of air delivery shown by old and worn-out engines. In the latter cases leakage plays an important part. Leakage through the inlet valves is a direct loss of air delivery. It can be heard, and is usually attended to for that reason. Leakage past the piston and back through the discharge valves causes not only direct losses in air delivery, but also indirect losses. Air heated by compression and slipping back to the inlet retains its high temperature while slipping back, and is raised to a much higher temperature during re-compression. The cylinder walls assume a much higher temperature, and what little air comes in is still further reduced in density.

The problem of determining the air delivery from the indicator card with a fair degree of accuracy then resolves itself into these two problems: First to eliminate leakage, second, to determine the factor for the reduction of density.

As before mentioned, leakage of the inlet valves can plainly be heard and is, therefore, eliminated, except in sadly neglected furnace plants, where nobody cares what the air delivery is. Leakage past the piston and through the discharge valves is not so easily found, unless the engine is equipped for discovering it. With equipment, its detection offers no difficulties. In Fig. 1, with valves B and C open, leakage of the upper discharge valves can be tested; with valves E and F open, that

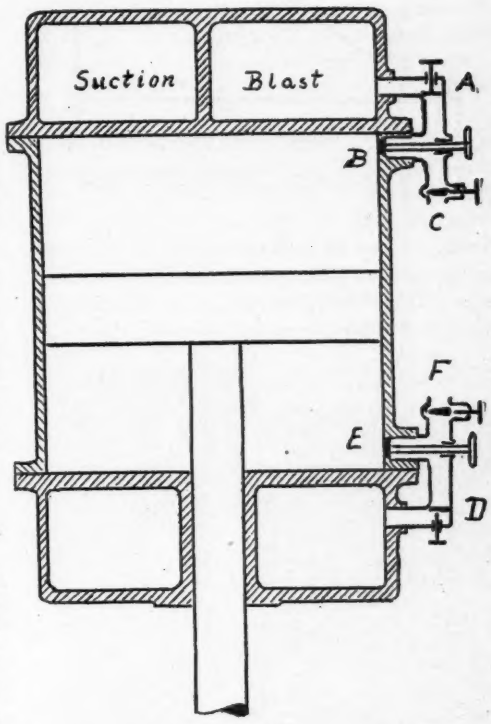


FIG. I.

of the lower discharge valves can be tested. With A and B, and E and F open, C and D closed, leakage past the piston is discovered. Indicator openings now serve the same purpose to a limited extent, but only very incompletely. In any well regulated plant, tests for valve and piston leakage should be made once a week. Leakage of the upper discharge valves can be estimated by placing piston in bottom position with valves B and C open and by rapidly closing B. The rate of pressure rise above the piston gives an indication of the valve leakage (provided that the piston is tight).

With leakage either eliminated or accounted for, the second factor, namely, the relation of air density outside of air cylinder can be investigated.

This factor, which means ratio of air density (at end of suction stroke) in cylinder to air density of cylinder, is always less than unity. It varies with the size of the air cylinder, with the area exposed to inflowing and outflowing air, with the time during which the air is in contact with the heated surface, and above everything, with the temperature range of the

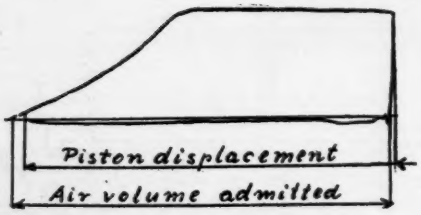


FIG. 2.

cylinder. Fortunately, the first three variables really vary very little in blowing engine practice, so that the influence of the temperature range is the only one which need be considered in practice. From tests made by the author and from tests published elsewhere, the following table was prepared:

Blast pres. lbs.	10	12	14	16	18	20	22	25	30
Density Factor	.93	.92	.91	.90	.89	.88	.87	.86	.84

Size of engine and design exert an influence which cannot be entirely overlooked, but conceding that influence, we may say that the values of the table are probably correct within 1½ per cent. either way. This means that for 20 pounds per square inch blast the factor may be as high as 89½ per cent. or as low as 86½ per cent.

A few examples will show the use of the tabulation. Fig. 2 is an idicator card taken from a blowing engine with mechanically operated piston inlet valves and with mechanically closed pot outlet valves. The apparent volumetric efficiency from the card is 97.2 per cent. Blast pressure is 17, hence density factor equals .895 which makes the volumetric efficiency equal to $.895 \times 97.2 = 87$ per cent. The air cylinder is of 9 ft. diameter with 5 ft. stroke; speed was 40 revolutions per minute, hence air delivery of that cylinder end is $.7854 \times 9^2 \times 5 \times 40 \times .87 = 11{,}000$ cu. ft. per min.

Fig. 3 is an indicator card taken from a blowing engine with automatic plate valves and with inlet pipe. It is evident that the pressure at the end of the suction stroke rises (due to the momentum of the air in the inlet pipe) above the atmosphere. The apparent volumetric efficiency is 100.7 per cent. The blast pressure is 15½ pounds which means a density factor of .903. The volumetric efficiency is $100.7 \times .903 = 91$ per cent. From the diameter of the air cylinder, the stroke and the revolutions per minute, the air delivery is easily found.

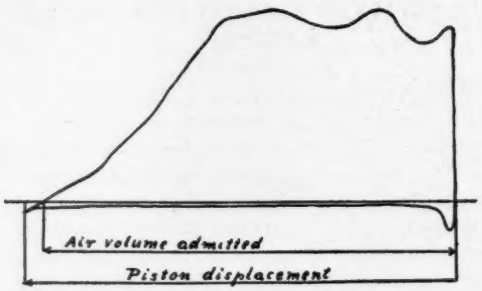


FIG. 3.

It is understood that, for the determination of the air weight passing through the engine, air temperature and barometric pressure at the inlet to the engine must be known.—*Blast Furnace and Steel Plant.*

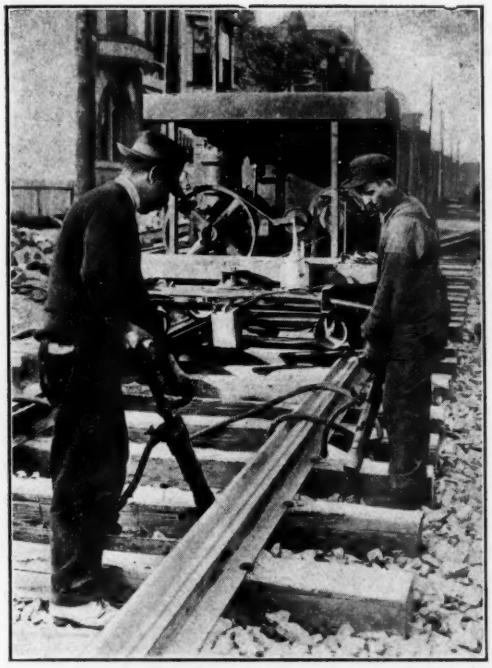
VARIED USES OF A PNEUMATIC TAMPING OUTFIT

BY CHARLES BRENNAN*

The acuteness of the labor situation in 1915 necessitated a substitute for track laborers, and as the larger steam roads in the East during the seasons of 1914 and 1915 were using pneumatic outfits with excellent results in ballasting track, this company turned its attention to the tamping question. After going into the situation thoroughly it was decided to try out the pneumatic type of tamper. An order was accordingly placed for equipment for a trial test, and upon the completion of this test, which was highly satisfactory, an order was placed for a gasoline-engine-driven pneumatic tamping outfit. The following description shows to what varied uses such an outfit can be put, and the economies which are effected thereby.

The first outfit obtained was gasoline-engine driven and it was purchased in 1915. With this equipment 12,714 ft. of track was tamped between Oct. 1 and Dec. 2, 1915, in addition to miscellaneous jobs completed. In the spring of 1916, a 10-h.p. motor-driven outfit was put into service as being more economical for an electric railway, although it had to be towed, whereas the gasoline outfit was self-propelled. Both outfits came from the Ingersoll Rand Company.

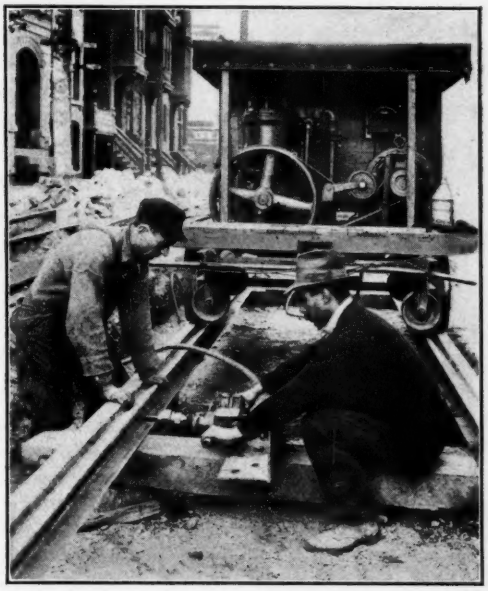
*Engineer Maintenance of Way, United Traction Company, Albany, N. Y.



TAMPING TIES.

At present a test, namely, that of using four guns instead of two, by the substitution of a 15-h.p. motor for a 10-h.p. motor and by changing to a larger pulley, which an Eastern railway property is trying out, is being watched with considerable interest. If the test proves successful, it is the intention of this company to remodel its outfit accordingly, as it now operates but two tamping guns. A compressor outfit mounted on a wagon that will operate from four to six guns will be built in the United Traction Company's shops during the coming winter.

In reballasting, where tracks are being reconstructed in connection with improvement of streets, and where traffic is being carried on continuously on both tracks, an outfit mounted on a wagon with wide tires is easier to handle than one equipped to run over tracks, since it weighs in the neighborhood of 4,500 lb. Where track is being reconstructed without traffic operating over it, the latter outfit can be placed on the tracks and can follow up the work, the operator moving the machine along as required. The present outfit is operated at a working pressure of from 70 lb. to 80 lb. without objectionable noise.



DRILLING RAILS.

TOOTHING OUT POCKETS IN BRICKS.

Under continuous traffic conditions, the average cost of hand tamping 6 in. to 10 in. of crushed stone ballast is approximately 15 cents per foot of track. This cost, however, is increased where a second tamping due to settlement is necessary or where the ties are not absolutely on a solid bearing, as cracks in the concrete base will appear where concrete is poured under traffic. This condition is minimized when the track is tamped by the pneu-

matic outfit, as the stone underneath the ties is very compact. Also, indifferent tamping by hand is eliminated. As the tamping guns work at any angle this outfit is especially efficient in tamping ties in special work and in corners where a tamping pick or tamping bar would be useless.

The average cost per day of tamping in 1915 by the pneumatic outfit was as follows:

DISTRIBUTION OF TIE TAMPING COSTS

Operator	$2.75
Two tampers	4.20
One ballast distributor	2.00
74.6 kw.-hr. at 1 cent per kw.-hr.	0.746
0.3 gal. compressor oil	0.075
0.5 lb. Polarine cup grease	0.045
Overhead*	1.08
Total cost per day	$10.896
Cost per tie	0.065

This tamping outfit cost about $1,300, the two tamping guns $100 each, and the tamping bars $1.75 each. As the pneumatic outfit is still engaged on tamping track, the average cost for 1916 has not been compiled, but undoubtedly will be higher, due to increased wages paid this year to all classes of labor. These figures serve to show a saving of approximately 56 per cent. A true comparison is the net result at the end of the season, and to keep the actual cost a job order is assigned to cover the operation of the tie tamper for the season in connection with a job order issued to cover the particular reconstruction job. At the completion of each job the cost of ballasting can be readily obtained. Another factor to be considered is the increasing number of laborers required on reconstruction work. The tamping outfit will take the place of at least ten laborers, and these laborers can then be used to good advantage ahead in tearing up and reconstructing tracks. Laborers were needed very badly during the past summer, and as most way engineers know there was not a job this year that had half its quota of men.

The municipal engineers of the several communities through which this road operates were so well pleased with the work of the pneumatic tamper that they requested that it be used on certain jobs, and having only one outfit we were kept busy moving it to the various municipalities when we could do so consistently.

*Charges based upon a life of ten years at 6 cents per tie (180 ties considered a day's work).

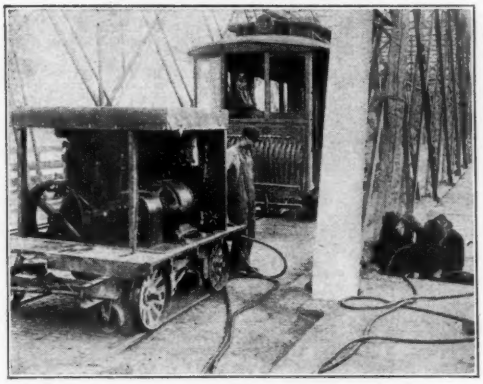
Excellent results in the breaking up of concrete base have been obtained by the following procedure. Rather than work continuously off the face of the concrete, as it has been our experience, the base can be removed more quickly by a series of trenches and cross trenches, and the slab between can be pried up and broken off with sledge hammers. The laborers operate guns with dull pointed bars at an angle of 45 deg. and at about 2 in. or

DRILL CUTTING OUT CONCRETE.

3 in. from the face, at the same time using the gun as a lever to pry up the concrete slabs. If they try to take off too much the drill will stick. In order to effect an economy it is necessary to let the men cutting trenches in the concrete get a good start so that the laborers breaking and loading the concrete will not be delayed.

In order to clean bridge rollers and seats from rust successfully it is necessary to remove the guns and cut down the opening in the hose to a small size, as the compressor will not build up or hold the required working pressure with a ¾-in. hose connection. This scheme was used on one of the big bridges and better results were obtained by using one line of hose instead of two. In removing rust one laborer uses a sharp instrument to break up scales, dirt, etc., and the air blast will take care of the rest.

For drilling holes up to 1¼ in. in diameter two rotating air drills are used to operate in connection with the outfit, and the results so



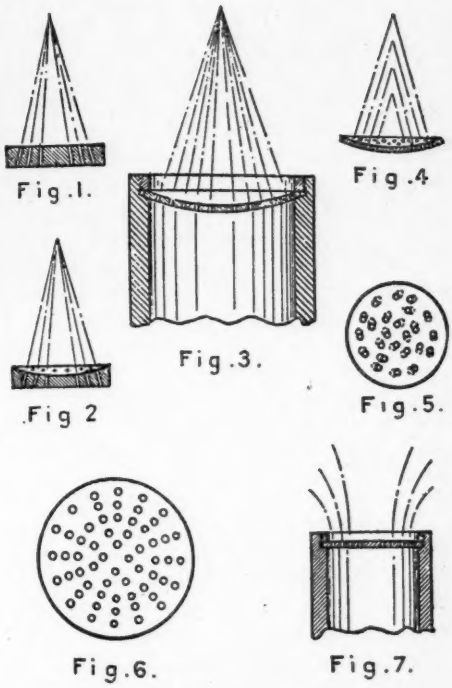
BLOWER FOR RUST.

far to date have been very satisfactory. It is proposed by this company to use the outfit for drilling bolt and tie-rod holes in the short pieces of rail which are cut during the winter months as soon as the tamping work is completed. This will not only effect a saving but it will speed up the replacement of broken rails.

Anyone who ever attempted to pocket out half bricks preparatory to laying new blocks knows what a tedious and unsatisfactory job it is. As a rule, the whole brick adjacent breaks off, which requires that it come out also. By using a pneumatic chipping hammer a series of sharp blows does the work without breaking the adjacent block. In order, however, to secure a good bond in the toothed portion it is necessary thoroughly to clean the cement out of the groove of the old block. In cleaning the old block the brick is placed against the edge of the curb, and a dozen bricks can be cleaned, as against one by the hand method. Not much cleaning of brick has been done on the street, the tamping requiring the machine almost constantly. The old bricks are hauled to the storage yard, and when the outfit is not in use it will be used to clean this old brick.

These examples show how an outfit of this type can be used, and it is necessary for every way engineer to be on the lookout for all labor-saving devices if an indication of the rising labor market is to be taken as a criterion. —*Electric Railway Journal.*

200,000 acre feet of water was drained from overflowed land in Holland in 4 months by electrically-driven pumps having a capacity of 120,000 tons of water per hour.



GAS BURNERS FOR INDUSTRIAL WORK

When it is considered that 0.5 per cent. of carbon monoxide in air is sufficient to kill a robust human being, and that 0.1 per cent. is dangerous and that this gas acts as a cumulative poison, the dangers to health caused by improper methods of combustion of gas and defective ventilation are obvious. Many of the objectionable features of gas as a means of heating metal or other cold surfaces are overcome to a degree by mixing the gas with air under slight pressure previous to its arrival at the point of combustion. This gives a form of blow-pipe flame, and it is possible by this method to add to the gas the exact volume of air required for complete oxidation. The result of adding the requisite quantity of air to the gas is to make the mixture explosive, and to prevent it exploding back into the mains the mixture must be allowed to pass through and to burn upon a thick gauze or perforated plate. Back explosion is also preventable by increasing the speed at which the gas is flowing through the mains. A combination of the two, namely, a thin perforated plate and the gas flowing at a fairly high speed governs the method adopted in a series of experiments

carried out recently by Mr. F. S. Sinnatt and described in the *Journal* of the Municipal School of Technology, Manchester.

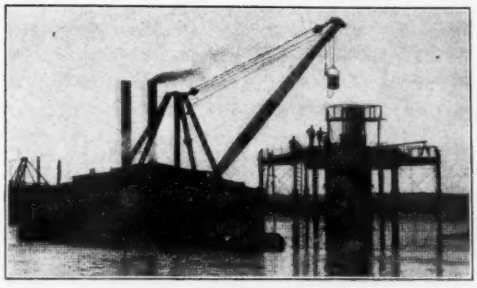
The flame obtained by burning gas in this way was carefully examined, with the following results:—When the explosive mixture is allowed to burn upon a perforated plate or gauze, each perforation forms a separate flame which is very short, but has a large circumference. In order to burn as much gas as possible on unit surface the perforations must be made close together, with the result that each small flame will tend to displace those near to it. The flame consequently sprays out as shown in Fig. 7. The spraying becomes a source of danger when the gases are under pressure, for while it is possible for each flame to appear to be burning properly when examined by the eye, yet analysis will show that the gas is escaping unconsumed. The reason for this was found to be that the flames on certain perforations in the plate were not burning properly, and this was especially the case with those perforations near the perimeter when small discs were used.

Further, the author noticed that with any variation in the size of the perforations, especially where some became enlarged and others closed with foreign matter, the length of the flames on different perforations varied and the surface had peaks which stood out above the remainder of the flame. In cases where the design of the burner was faulty and the gas travelled down a main and then directly on to the perforated plate the rate at which the gas was flowing through the centre perforations was greater than through those near the perimeter. The flames, therefore, projected in the centre. If any of the above uneven flames are made to impinge against a cold metal surface a part may be extinguished or only partially burned, with the result that the gas escapes combustion. This is aggravated by the fact that the pressure and the composition of commercial fuel gases cannot be maintained at a constant figure, and that the flames are frequently employed in some machine which is subject to more or less violent vibrations.

Many of the above difficulties are overcome by making the perforated plate or gauze concave on the side upon which the gas is burning. The perforations should have a common focus as in Figs. 1, 2, 3, and 6, which can be varied by varying the degree of concavity of the plate—generally the perforated plates are made in the form of small circular discs, the size varying with the type of burner for which the disc is required, but usually ½ in. in diameter. The perforations in small groups may have a focus of their own as in Fig. 4. The whole of the flames burning on each of the separate perforations are thus made to pass through a common point, or the flames are focussed. The effect of this treatment is to overcome within wide limits any variations in the composition of, or the pressure of, the gas. It is nearly impossible for the gas to escape combustion owing to it having to pass through the common focus. The combustion of the gas is in a degree self-induced, and the rate at which the gas burns on the plate is increased by the thorough mixing which occurs. Differences in the size of the perforations cannot influence the flame to the extent they do on a flat perforated plate.

The flame upon a concave perforated plate or "dished disc" assumes a fairly perfect conical form, and after leaving the point of focus the burned gas is in a single stream. The point of focus of the plate may be considered to be the place at which complete combustion for the system will take place, and this may be taken as marking the point at which the flame may be brought into contact with cold surfaces. The distance this point is from the plate may be varied according to the design of the particular machine or plant in which the burner is required. The fact that the whole of the flames pass through the common focus causes that point to assume a maximum flame temperature. The degree of concavity required for different pressures and for fuel gases of different compositions was determined experimentally for the gases which have been burned by the system. The size of the perforations and the thickness of the metal of the plate are factors which influence the concavity necessary for any particular gas. At present the method adopted practically is to use small discs about ½-in. in diameter and to fit these into any type of burner; the number of the discs being varied according to the volume of gas to be consumed.

Just half a century ago the first shaft on the Calumet and Hecla was started. Since that time $130,750,000 in dividends has been distributed, equal to $2,615,000 per year since inception of the enterprise.



DERRICK AND CAISSON.

THE DEEP WATER PIERS AT HALIFAX

In the immense harbor improvement scheme now in process of realization at Halifax, Nova Scotia, the layout is for a passenger landing quay to accommodate the largest steamers afloat with buildings, railroad yards, conveyor tunnel and six piers 340 ft. wide and 1,250 ft. long separated by basins 350 ft. wide and 45 ft. deep. The piers and basins will provide berthing space for 27 large steamers at an estimated cost of $860,000 each. The sides of the piers are solid masonry walls 31 ft. thick made of courses of 22x31-ft. hollow, reinforced concrete shells 4 ft. high filled with concrete and rubble. The walls are founded on rock at a miximum depth of 60 ft. where they are seated on a rubble stone footing; in water not more than 45 ft. deep the rock foundations are leveled by drilling and blasting with drill boats and with a diving bell. In some places where the surface of the rock is too deep to be leveled by machinery and not deep enough to admit the use of a rubble footing, a concrete footing is placed under water in 64x120-ft. steel sheet pile cofferdams.

DIVING BELL WORK

Construction is now in progress on the passenger quay and one pier and basin where part of the surface foundations have been prepared by a diving bell or movable pneumatic caisson. This machine has a structural steel framework and a 25x38-ft. working chamber with concrete walls and a concrete roof about 2½ ft. thick. The structural steel framework of the working chamber is connected to the bottom of a skeleton tower of the same lateral dimensions with an open, central steel wall 11 ft. in diameter containing the airshafts and extending to the top of the tower 66½ ft. above the cutting edge. The lower end of the well is enclosed in a rectangular ballast tank 9 ft. high inside, covering the top of the working chamber and having walls and roof of solid 12x12-in. courses of timber. The working chamber is accessible through a 30-in. material shaft and a 30-in. man shaft adjacent to which the necessary air, water, and service pipes are provided.

The diving bell is sunk and a load of 40 tons on the cutting edge is produced by filling the ballast tank and well with water. It is raised by removing the water ballast and the buoyancy of the heavy ballast tank brings it to the surface. The working chamber will be operated under 20 to 25 lb. above atmospheric pressure.—*Contracting.*

COMPRESSED AIR FOR SALVING WRECKED SHIPS

Mr. W. W. Wotherspoon, who may be called the supreme expert in marine salvage, at least by the aid of compressed air, recently gave an interesting address before the Brooklyn Engineer's Club, an abstract of which is here presented:

Salvage conditions vary more or less with each case that is undertaken, and the devices and arrangement employed have to be adapted, often with much ingenuity to the specific requirements. Salvage contracts may be of three or more types: first, no cure no pay; second, no cure no pay except for a guarantee of certain charges; third, straight day's work.

DIFFERENT METHODS FOR RAISING SHIPS

Some vessels are raised after enclosing them in cofferdams, as, for instance, the notable *Maine*. Some may require to be merely patched and pumped out, and many are pulled off the bottom by lines attached to anchors, which are very much more efficient and positive than the efforts of the strongest tugs pulling directly. In some instances interior wood cofferdams are constructed in the vessels and enable the salvers to reach otherwise inaccessible places where portions of these ships may be repaired.

It would seem that for salving deep water vessels compressed air pontoons would be very efficient but owing to the great dimensions and corresponding cost of pontoons large enough to be serviceable for this purpose, none of the salvage companies employ them except for minor cases. For heavy work they should have a lifting capacity of at least 200 tons each and few or none such are in service except for one or two foreign governments.

STOPPING LEAKS

It is surprising to note how few leaks in a wrecked boat require calking; most of them are comparatively small cracks, open rivet holes, or openings around pipes, at imperfect flanges, etc. These can be easily closed and this generally suffices to make the vessel sufficiently water tight and air tight.

As most of the cracks in a vessel's deck are likely to be narrow, very often they may be patched without involving a difficult and unreliable system of shoring which is likely to become loose at the most critical moment, by a method devised by this company. It simply consists of drilling and tapping two or more holes through the deck and screwing into them bolts by which a 2x10-in. dry white pine plank is firmly held down over the crack and when it becomes wet swells and affords sufficient water tightness. Wrecked vessels must not only be pumped out but sometimes they must be ballasted and an interesting instance of the latter work is a vessel which was easily and successfully stabilized by the construction of wooden water tanks on her deck.

FLOATING WITH COMPRESSED AIR

Compressed air is used very widely for expelling the water from sunken ships, and at the same time furnishes very convenient power to operate drills and other tools. As the large majority of the injuries to vessels are on their bottoms the collection and maintenance of compressed air in the upper part of the hold is not affected by the holes through which it forces out the water, and the ship may be easily handled provided the decks and bulkheads sustain the heavy pressures.

THE WOTHERSPOON SYSTEM

To relieve excessive pressure the Wotherspoon system of graduated pressures in successive compartments has been used, and with it the inner compartment may be put under a very heavy pressure and the adjacent ones simultaneously put under somewhat lighter pressures, and so on, reducing the pressure outwards so that each bulkhead or deck has only to sustain a difference in pressure between the two adjacent compartments. Of course when a vessel is raised rapidly from a great depth under heavy pressure great care must be taken to prevent rupture by the unbalanced interior pressure as the exterior pressure is relieved. This often can be accomplished with a large open relief valve, as for instance, a submerged gooseneck which provides for automatic equilibrizing.

DIVING OPERATIONS

Divers' work often requires exceptional skill, courage and perseverance, and it may be of such a complicated nature as to make it difficult to decide between several plans for accomplishing the same end. This was the case with a vessel from which a large amount of silver bulletin was salvaged from the storeroom so located that it could only be reached by one of two difficult methods. By one of these it was necessary to cut a very large hole in the side of the submerged vessel and thus badly damage the structure. By the other method of cutting a smaller hole the three divers were subjected to great risk in proceeding clear across the vessel on a steep incline and through complicated and tortuous passages. The latter method was eventually successfully used.

DIVING UNDER HIGH PRESSURES

Although the work of the divers under compressed air is comparable with that of pneumatic caisson work and tunnel work, its limitations practically differ widely from the latter and divers have to go to depths of 150 or 200 ft., or even more, involving a much higher pressure than is considered practicable for caisson work. In the case of the Empress of Ireland, sunk in about 160 ft. of water, the divers descended as rapidly as the pressure in their suits could be balanced with the external pressure, and also ascended rapidly after a short period of work. As it had been observed that bad effects from decompression rarely showed themselves within 10 minutes after emergence, the men were allowed to come up quickly and were immediately placed in a hospital lock similar to those used for caisson work, and for a short time put under a pressure about one-third of the maximum to which they had been subjected under the surface. Later the pressure was reduced to one-sixth and maintained for a long time, and eventually to a still smaller proportion and maintained for several hours, a routine which proved entirely successful.

SEVERE AND FATAL ACCIDENTS

One diver lost his life through a rather unusual accident, namely, that of falling down

a steeply inclined deck to a depth of about 60 ft. greater than he had been working in and thereby experiencing such a shock that he died very soon after being drawn to the surface.

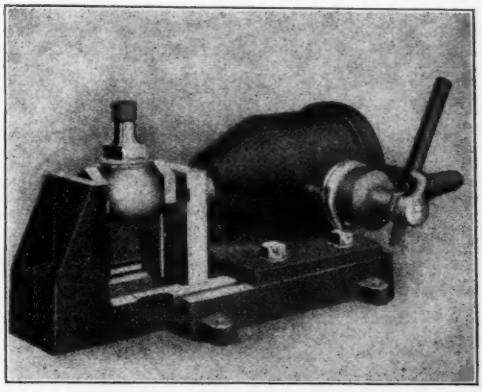
Diving was successfully carried on at a depth of 200 ft. in salving an English submarine where all of the divers escaped in safety except one who was the victim of an accident resulting in his becoming so badly entangled at the bottom that it took 12 hr. work by his companions to release him. At the time of his release the conditions of wind and tide were such that it was not safe to raise him to the surface and he therefore remained below 12 hr. longer and was then drawn out alive, although he died soon afterwards, more, it was believed from the result of the exhaustion and exposure than from direct compression. The other divers on the same job remained below the surface only about 15 or 20 min. and did not suffer therefrom. The greatest depth attained by a diver is 312 ft. which is the depth at which a United States submarine was sunk in the Philippine Islands. The divers worked 15 or 20 min. at this depth and then took from 6 to 8 hr. to ascend.

English experiments with tanks under artificial pressure indicate that divers can safely work under suitable conditions to a depth of 600 ft. and elaborate and comprehensive rules to govern their operations and insure their safety have been prepared from these experiments.

MOVING A SUBMERGED BRIDGE SPAN

In the discussion of Mr. Wotherspoon's paper, Mr. Frank W. Skinner described a remarkable application of compressed air and steel pontoons to the attempted salving of a long span of the Cornwall Bridge across the St. Lawrence River which after it was entirely completed fell on account of the collapse of one of its piers, and lay, substantially uninjured, on its side with the two trusses in horizontal planes in deep water with a current of 6 or 8 miles per hour. The current was so great that single piles driven in the river bottom were quickly broken by its force and fenders could only be constructed by driving clusters of piles and holding them until they could be chained together. Divers could only be sent down under shelter of strongly guyed vertical trough-shape steel shields with ladders on their concave faces turned downstream.

A number of air tight steel cylinders with valved inlets and outlets were floated over the spans, sunk into position parallel and adjacent to vertical posts of the lower truss and chained to them by divers. Compressed air hose was then attached to the cylinders, their valves opened, and air pumped in to expel the water until the increasing buoyancy of the cylinders lifted the span nearly to the surface of the water and enabled it to be moved down stream towards a sheltered position where it was intended to dismember it, remove the pieces of the structure, and re-erect them in the original position. Before it had quite reached a safe position it again grounded and although a larger amount of time and money was expended in trying to float it again the efforts were unsuccessful and the attempt finally had to be abandoned and the span destroyed.



PNEUMATIC VISE AND PIECE OF WORK.

A MACHINE SHOP VISE

The half-tone shows an air operated vise built by the Hannifier Manufacturing Company, Chicago, which should be a serviceable tool in almost any machine shop for holding small work on the shaper, miller, drill, etc., little explanation being required as to its construction or operation, which of course is instantaneous. The diameter of the air cylinder is 6½ inches and with the ordinary shop air pressure it can be made to apply a squeeze of more than one ton. False jaws may be applied to fit articles of special shapes and the space between the jaws may be adjusted according to requirements. The vise as here shown is 19-in. long over all and weighs 80 lbs.

COMPRESSED GAS AS A MOTOR FUEL

The use of compressed coal gas as fuel for motor cars has been pondered in many quarters during the last ten years, but so long as gasoline and its substitutes were fairly plentiful, the proposition was not considered good enough to warrant money being spent upon it. To-day, in view of the scarcity of all liquid fuels, there is a good deal more in its favor, and the Municipal Corporation of Glasgow has been carrying out some tentative investigations into the question. The results, while anything but conclusive, show, at any rate, that a motor vehicle can be worked successfully on gas, and point to the desirability of further experiments.

The initial disadvantage under which compressed gas labors, as compared with liquid fuel, is the space it occupies, and the weight of the cylinders required to contain it. A cylinder containing 100 cubic feet of oxygen at 1,800 pounds pressure weighs 120 pounds and measures 4 feet 7 inches in length. The cylinders for motor car use should be of large dimensions, so that the pressure can be kept as low as possible; hence the balance between pressure and volume must be very nicely adjusted, so that there shall be no undue sacrifice of reservoir capacity to lightness of load, or of carrying space to cruising radius. Two cylinders of not less than 8 cubic feet capacity could be placed one on each side of the chassis, below the footboards, between the front and rear wheels; but three cylinders would be even better, and the third might be placed at the back of the rear wheels, across the chassis. The greater the capacity of the gas cylinders, the lower the pressure required for a given quantity of gas; and, on this principle, the cylinders could be made much lighter and the working cost reduced all around.

A good deal of difficulty was experienced in devising a governor which would permit the training down of the gas cylinders so that the gas should issue at the outlet side of the governor at constant atmospheric pressure; allow for the passing of any quantity of gas up to 200 cubic feet per hour; and work without variation despite the jarring and jolting of the roughest roads.

This was at length accomplished. In the governor adopted the bell is of rubber, and the high pressure counter-balance on the valve stem is of leather. Between the high pressure storage cylinders and the motor a low pressure expansion cylinder was found to be necessary. The ordinary fuel tank was found to answer this purpose very well. As regards replenishing the storage cylinders with gas, it is proposed to use the car motor for the purpose, the pump to be operated from the gear box or connected up to the motor by a special clutch-gear.

It is hardly to be expected that compressed gas will ever compete with liquid fuel for cars traveling long distances, but there is no reason why it should not be cheap and satisfactory fuel for town vehicles working on comparatively short rounds. If the car can be made to do its own charging without unduly complicating the mechanism, or adding too much to the weight, the provision of charging stations would be simplified.—*Scientific American.*

AIR COMPRESSOR INDICATOR DIAGRAMS

The indicator diagrams on the opposite page, reproduced from a recent issue of Power, and contributed to that publication by Mr. R. S. Hawley, were taken from the air cylinders of a two-stage tandem air compressor, and they tell an interesting story. They show especially the importance of taking indicator cards at frequent intervals and they tell how badly a compressor may be performing when this is neglected.

The indicator in this case was apparently only thought of when other signs insistently showed that things were wrong. The compressor was pounding badly, its strokes were not uniform, the low pressure cylinder got very hot and, most important of all, the working pressure could not be maintained in the receiver.

It was evident from the first that the inlet and discharge valves, especially the latter, were not properly functioning. These valves are of the spring-poppet type inserted in cages and the cages screwed into the cylinder head. The inner end of each cage presses against a copper gasket, which should prevent leakage at that point.

The first cards taken were Figs. 1 and 2, from the low pressure and the high pressure cylinder respectively. Comparing these with Figs. 5 and 6, taken from the same cylinders after everything had been restored to approx-

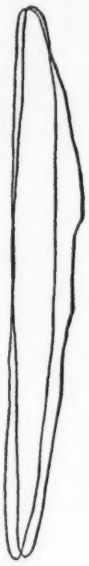


FIG. 2

FIG. 4.

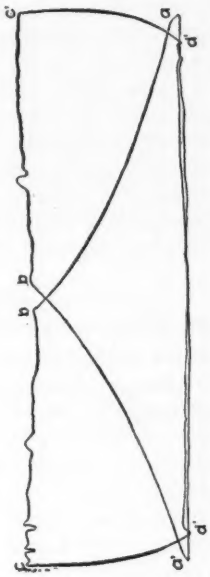


FIG 6

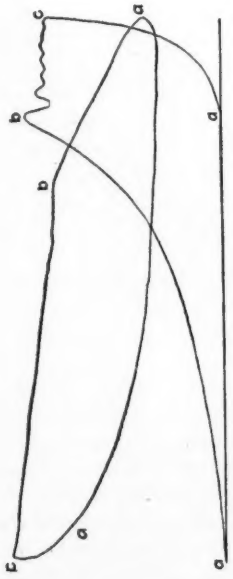


FIG 1

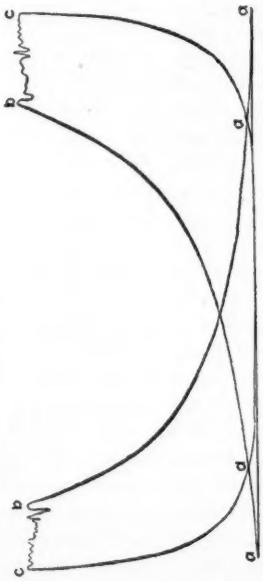


FIG 3

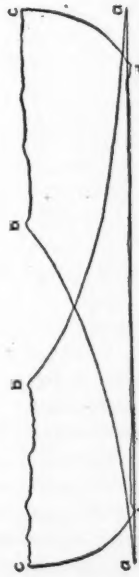


FIG 5

imately normal working condition, the contrast is astonishing. Of the four separate diagrams embodied in Figs. 1 and 2, only that from the head end in Fig. 1 is at all recognizable as a proper indicator card, the others being so bad that it is not worth while to try to understand their indications.

The valves of the low pressure cylinder were examined first and it was found that the gaskets under the cages were all defective or broken out, thus allowing the air to flow back into the cylinder on the return stroke after the compression. After these gaskets were renewed Figs. 3 and 4 were taken. Fig. 3 would

pass for a tolerably respectable pair of cards from a single-stage compressor, which in fact they were, as Fig. 4 shows that the high pressure cylinder was doing none of the compressing.

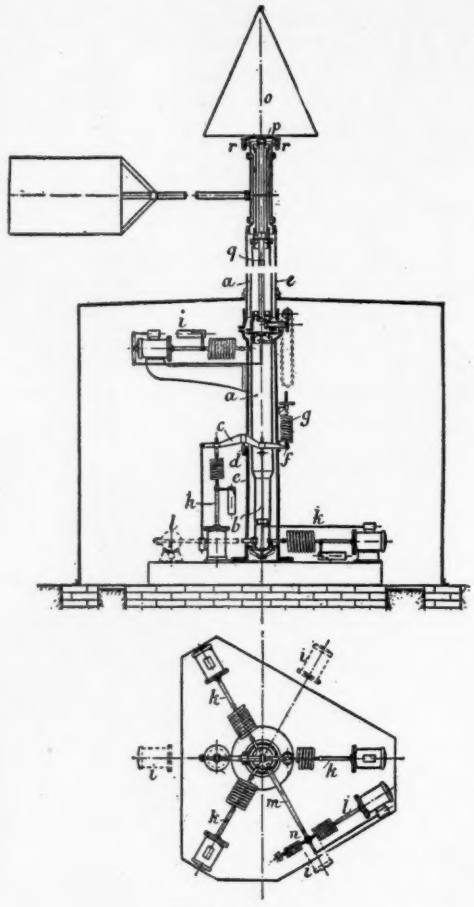
After the jackets had been renewed on the high pressure cylinder also, Figs. 5 and 6 were taken, showing each cylinder doing its full share of the work as determined by the terminal pressure and the ratio of the cylinder diameters.

MEASURING WIND FORCES*

Devices in use for measuring the wind pressure against plane or curved surfaces consist generally of a two-armed wind-mill carrying the surfaces in question, actuated by weights and connected with the beam of a balance. The velocity of rotation in still air is observed, and from this is calculated the force exerted upon the surfaces by a wind of known velocity. But in this way is obtained only the absolute value of the horizontal and vertical components of this force, with no indication either of its direction, of its point of application, or of its effective strength—all matters of great interest in the study, for instance, of the effect of the shape and inclination of the exposed surface upon the center of pressure of a wind of given velocity.

The Giessen indicator, which we describe herewith, has been awarded first prize in a competition, held under the combined auspices of the German ministry and several German technical associations, with the view of elaborating an instrument for the measurement of these items. It makes possible the separate determination of all components, and consequently of the direction and the point of application of the wind force upon the surface under discussion.

The apparatus (Figs. 1 and 2) consists of a tubular column, *a*, housed in a tube, *e*, which protects it against all direct wind action. The tube, *a*, is supported by means of a rod, *b*, connected with a lever, *c*, which in turn rests upon two springs outside the external tube, *e*. One of these, *g*, is adjusted to balance exactly the dead weight of the tube and the testing surface which it carries; the other, *h*, then measures the force of the vertical movement



FIGS. 1 AND 2.

caused in the tube by the pressure of the wind.

The horizontal forces of this wind, and the oscillatory elements of the tube, *a*, under its pressure, are determined by two groups of three springs each, *k* and *i*, attached to the tube, *a*—the first group at a certain height above the foot of the apparatus, the second at this foot. Finally the forces of torsion resulting from application of the wind force are measured by a spring *l*, operated by the lever arm, *m*; a second spring, *n*, prevents all play of this arm, holding *l* in a state of constant tension.

At its upper end the tube carries a small plate, *p*, upon which is fixed the surface *o* being tested. This plate can be given any position desired with reference to *a* by means of a shank, *o*, fixed to *p* and adjusted from out-

**Scientific American Supplement. Translation from Le Genie Civil.*

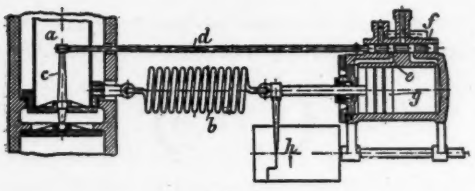


FIG. 3.

side the tube. On the other hand, this plate, *p*, can be rigidly fixed to *a* by means of the screws, *r*. These pass through holes in a socket which is provided with a little vane in such a way as to make it possible to maintain the testing surface in any desired relation with the direction of the wind.

The apparatus measures directly the vertical force transmitted by the tube, as well as the torsion forces. Horizontal forces, on the other hand, whose directions and intensities vary with the direction of the wind, are decomposed into three components at angles of 120 degrees with each other.

In measuring these components, since the movements of the tube naturally are of small amplitude (one millimeter, more or less), it is necessary, in order to secure accurate measurement, to use an auxiliary and automatic connection which shall at once measure and record the movements in question. This is represented in Fig. 3. It consists of a small compressed air cylinder in which moves a piston, *g*, directly connected with the spring, *b*. The latter, which we suppose to be attached to the tube, *a*, of the previous figures, represents any one of the springs of those figures. The lever, *c*, which moves with the tube, is joined to the rod, *d*; and this rod operates the valve, *e*, of the air cylinder, which can slide back and forth in the valve-box *f*. Finally the piston-rod, *g*, is joined to a recording needle, which is displaced upon the drum, *h*, with every movement of the piston.

A displacement of the foot of the tube to the left, for instance, pulls the valve, e, in the same direction, establishing the left-hand connection and admitting air to the left-hand face of the piston. This then advances to the right, stretching the spring, *b*, until the tension is just sufficient to pull the tube in the same direction back to its original position. This movement returns the valve *e* to its initial central and neutral location, arresting the displacement of the piston, *g*, by shutting off the supply of compressed air. Displacement of the tube in the opposite direction similarly brings about admission of the air through the right hand valve to the right of the piston, and a movement of this piston to the left, relieving the tension in the spring sufficiently to permit the return of the tube to normal position. In each case the amplitude of the piston movement, which, of course, measures the variation in tension of the spring, and through it the force of the wind, is recorded upon the drum.

In the indicator represented in Figs. 1 and 2 all of the springs, *h*, *i*, *k*, and *l*, are provided with this attachment, and are so placed that the return of the tube, *a*, in the direction contrary to the tension of the springs is effected without the latter ever being under compression, or even completely relaxed. The very slight play of one millimeter in every direction which the tube enjoys is sufficient to generate rapidly and without oscillation the movements of the pistons which work these springs.

BLASTING WITH QUICKLIME

The expansion of quicklime when wet develops an enormous force that acts slowly and almost irresistibly and has long invited use for mechanical purposes. A well-known engineer and contractor has spent a large amount of time and money trying to adapt it to raising heavy weights, as in underpinning buildings and other structures and more successful efforts have been noted in a recent issue of *Rock Products* that describes its efficient use in breaking up heavy brick masonry. A number of 12x20-ft. piers, 12 ft. high, were located between similar foundation piers for engines in operation and it was necessary to remove them without injuring the machinery. Blasting was therefore inadmissible and hand cutting and breaking too slow and expensive. The work was accomplished by drilling 3-in. vertical holes 3 ft. deep and 3 ft. apart in both directions over the entire areas of the piers and filling them within 6 in. of the top with fresh slacked lime in pieces ½ to 1½ in. wide. As soon as the lime was thoroughly wet the tops of the holes were filled with brick drilling well tamped and in about 10 min. cracks started in every direction and the entire top of the foundation pier was broken into 3-ft. cubes. Careful work was necessary since there was some danger of the tamping being blown from the tops of the holes.

MOTOR CONDITIONS AT DIFFERENT ALTITUDES

It is a known fact among aviation experts and aviators that at high altitudes the engine will not produce the power that it will when flying at sea level. This has caused considerable trouble to exhibition fliers and cross-country pilots when they wanted or tried to make flights from high altitudes, or had to make a high altitude in order to accomplish their purpose.

This reduction in power is due to the decreasing of the air pressure the higher up the machine climbs. At sea level, the atmospheric pressure is 14.7 pounds per square inch; at 5,000 feet above sea level, the pressure is 12.13 pounds per square inch, approximately, and at 10,000 feet, the presure is 10.0 pounds per square inch. It can be readily understood then, after the piston has driven the gas into the compressed condition ready for firing, that the final pressure so attained would vary as the atmospheric pressure dropped, the gas pressure in the cylinder would also drop, and when this takes place there is not as much power in the charge as there would be at a lower altitude or higher pressure.

Table showing atmospheric pressure at various altitudes.

Height.	Pressure. Lbs. Sq. Inch.
Sea level	14.7
1,000 feet	14.2
2,000 feet	13.6
3,000 feet	13.1
4,000 feet	12.6
5,000 feet	12.1
6,000 feet	11.7
7,000 feet	11.25
8,000 feet	10.8
9,000 feet	10.3
10,000 feet	10.0

The common compression ratio for an average motor is 4.5 to 1. That is, the air space above the piston has 4.5 times the volume when the piston is at the bottom of its stroke than it has when the piston is at the top of its stroke. This figure 4.5 is chosen because it is considered to be the best for maximum horsepower, and is one where the compression pressure will not be so high as to cause pre-ignition.

By having given the compression ratio, it is possible to determine the final pressure immediately before ignition by the formula:

$$\left(P' = P\frac{V'}{V}\right)^{1.3}$$

Where P′ is the compression or final pressure, P is the atmospheric pressure, and $\frac{V}{V'}$ is the compression ratio of 4.5, $P' = 14.7\ (4.5)\ 1.3 = 104$ pounds per square inch, absolute, at sea level. Since this pressure comes directly from the compression ratio, it is the most efficient final compression pressure at sea level for an egnine with such compression ratio.

This same engine at an altitude of, say 7,000 feet, however, would have, since the atmospheric pressure at 7,000 feet would be 11.25 pounds per square inch instead of 14.7, as at sea level, $P' = 11.25\ (4.5)^{1.3} = 79.4$ pounds per square inch, absolute, which is 25.6 pounds per square inch less than the most efficient pressure, above determined. It is clearly evident then that not as much power will be obtained as when the engine was at the lower altitude.

These pressures calculated above are all "absolute," and by that is meant that the atmospheric pressure is also included in the figures, and in order to get the compression above atmosphere, the atmospheric pressure used in the calculations must be deducted. In the figures given, 104 — 14.7 gives 89.3 pounds per square inch, at sea level, and 79.4 — 11.25 gives 68.15 pounds per square inch at 7,000 feet.

In order to bring the final compression pressure up to the efficient figure, a different compression ratio would have to be used, that is, the final volume would have to be less, and since it is impossible to vary this to meet the conditions of altitude, the loss of power cannot be helped unless some arrangement could be devised whereby the compressoin ratio could be increased or decreased at will by reducing or increasing the space above the pistons when on top center. Then, if the ratio be thereby increased to some figure like 5 to 1, the motor would again have its proper final pressure, but even then, not as much power would be developed as at sea level, owing to the further fact that, with a constant final compression pressure, the horse-power varies directly as the atmospheric pressure. For example, the horse-power of an engine develop-

ing 80 horse-power at sea level when raised to an altitude of 7,000 feet would be equal to $\frac{11.25}{14.7}$ = 61.2 horse-power. If the original compression pressure of 4.5 was used in circulating the drop in horse-power would be even greater.

These computations and remarks make it very clear that the flier or builder who contemplates any altitude work must see to it that sufficient surplus power be provided to allow for any variation or loss of power resulting from such altitude work.—*Aircraft.*

AN ENGLISH PNEUMATIC MOLDING MACHINE

The illustrations here reproduced from *The Engineer,* London, show the essential features and mode of operation of a new foundry molding machine built by Blakeborough and Sons, Brighouse, England.

General views of the machine are shown in Fig. 1, the first showing the machine in what may be called its normal or initial position and the other views the relative positions of the parts at different stages of the work. In Figs. 2 and 3 the machine is shown in elevation with the operative parts in two different positions, and in Fig. 4 are given details of the table and mold box.

It will be seen that the table A is mounted on trunnions B carried in bearings in the uprights C. To the underside of the table, Fig. 2, is attached a pneumatic cylinder D, with a piston E, the latter being connected to a crosspiece F. Secured to each end of the crosspiece is a vertical rod G, which passes through a slot in the table on each side of the box H. The upper ends of these rods are connected to a crosshead J, which carries the ram K. The mould-box is provided with a movable vibration frame L, to which the pattern plate M is secured. A three-way valve and pipe N passing through one of the trunnions conveys the air under pressure to the cylinder, so that the piston is driven downward, bringing the parts into the position shown by dotted lines in Fig. 2, and the pressing ram compresses the sand in the mould-box or flask. The pressure on the piston is then released by means of the three-way cock, and the piston is forced back

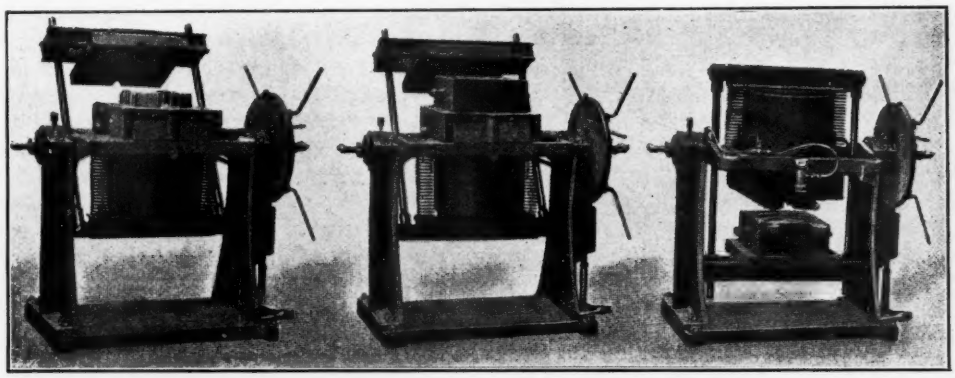


FIG. I.

into the cylinder by means of powerful springs O shown, and the surplus sand is removed. Pressure is then re-admitted by means of the three-way valve, and the pressure plate is again brought down on the box. When this operation is completed a roller on the end of the rod P, connected to the treadle Q, is withdrawn by pressure of the foot of the operator from an opening on the periphery of the hand wheel R, which is secured to the axis of the table. The wheel is then turned by hand through half a revolution, and the cylinder ram and box are turned to the position shown in Fig. 3, the table and parts being locked in their inverted positions by the engagement of the treadle mechanism with another recess in the hand wheel R. The air pressure is then released from the cylinder, and the crosspiece F is returned to the normal position shown in dotted lines in Fig. 3, owing to the action of the springs above mentioned. By means of the connecting-rods G the crosshead J and ram K, with the mould-box, are correspondingly lowered while in their in-

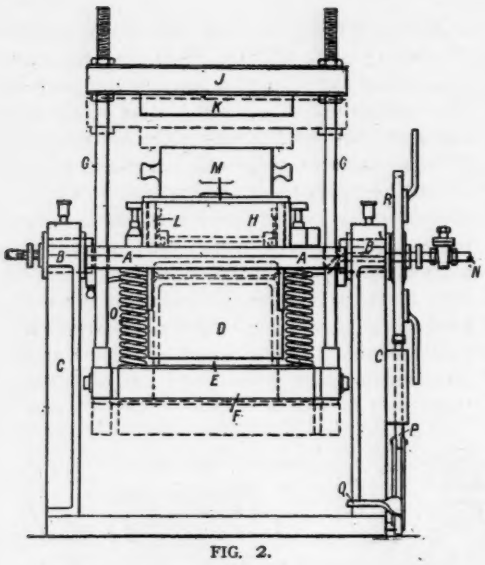


FIG. 2.

verted positions. Simultaneously the pattern plate and mould are lowered by means of the mechanism shown in Fig. 4. This comprises a system of levers, pins, and springs S, T, U. The machine is fitted with a vibrator W secured to the frame as shown. When the mould box is clear of the pattern plate the box, with the pattern or mould uppermost, can be lifted from the pressure block or ram on which it rests, and transferred to the floor. By depressing the treadle the roller on the end of the rod P is disengaged from the notch in the wheel R, and the latter is revolved by hand through half a revolution, bringing the various

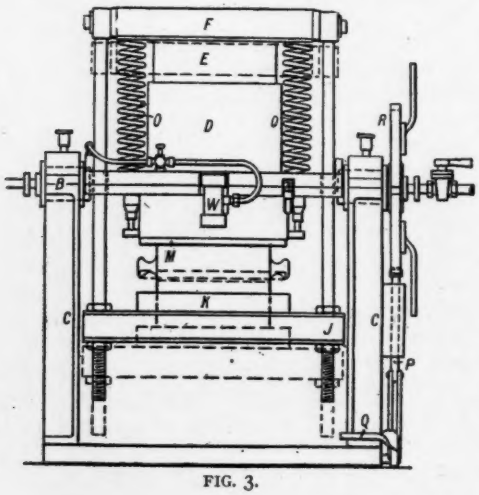


FIG. 3.

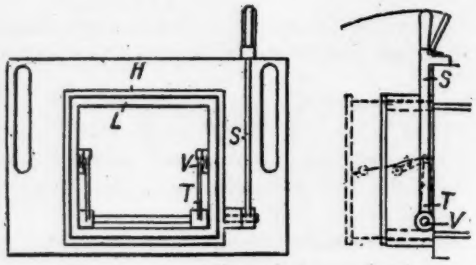


FIG. 4.

parts back to their original position, shown in Figs. 1 and 2, the pivotal connection of the rods G to the crosspiece F admitting of the crosshead J being moved to the rear of the machine, so as to give free space above the pattern plate for placing the molding box in position.

The machine is very simply and rapidly operated, and the impressions in the sand are sharp and clean. For the complete operation of making a set of six deep molds from a pattern plate in the foundry of the builders the time occupied was 1¼ minutes.

VENTILATION, CHILLS AND COLDS—ENGLISH AND CONTINENTAL PRACTICE

The question of ventilation is treated very differently in different countries. We in England are, or pretend to be, inured to chills and not very apprehensive of draughts, and think that this is a manly attitude. But on the Continent people often insist upon shutting railway-carriage windows when the Briton bares his brow to the wintry blast with complete (or pretended) indifference. Hence certain quarrels we have witnessed. Which is the right attitude?

Our theory appears to be based upon the view that we do not get chills when walking in the open air, and indeed feel the benefit of such exercise. But a person who is sitting in a draughty room or railway carriage is not taking the exercise which warms him against the cold of the atmosphere when he is walking. During a long railway journey we may become thoroughly chilled and open to the attacks of the numerous germs which are living upon our skin, throat, nose, or elsewhere, waiting for an opportunity to enter the deeper blood or tissues, or of other germs which may be hiding in the carriage cushions. The cold air may perhaps impede the attacks of the

latter germs, but will tend, by chilling the patient, to encourage the former ones. On the whole, then, the case for sitting in draughts may be questioned; and there are numbers of subsidiary factors which are usually ignored—such as excessive meat-eating, alcohol, previous illness, and so on. Our theory that a close room means much poisoning with exhaled matter has been rather exploded by the work of Prof. Leonard Hill and others. It may be that the danger of being thoroughly chilled is much worse than the danger of infection by germs floating in the air of a close room. At all events, many people declare that they get colds by sitting in draughty places, while others say they get them by going to crowded assemblies in ill-ventilated halls.

Our mode of life is based upon our theories. Our sash windows are probably the most irrational things in creation. They appear to have been first invented in Holland, and brought over to England toward the close of the seventeenth century, in place of the rational French windows. It must have been a curious person who invented the former, which are often dangerous owing to the breaking of the cords, while a draught is always pouring in between the two sashes. What their advantage is, no one can understand, and we are glad to see that they are now being replaced again in new houses by the French windows. On the other hand, French windows, as will be easily seen anywhere on the Continent or in Egypt or elsewhere, may be closed to exclude either draught or noise. Moreover, seldom if ever do we have double windows such as are used throughout Northern Europe.

Our open fires do not warm the rooms, while they flood the atmosphere with particles of carbon, and are the most wastful method of producing artificial heat. On several occasions the writer has left England in the depth of Winter for Russia; Germany or Sweden, and has never been cold until he returned here. On one occasion a Canadian told him that England is the coldest country that he was ever in; and most foreigners make the same exclamation. In Russia the double windows are kept closed nearly throughout the Winter; the house is ventilated by proper arrangements of pure heated air brought up from the basement, with a great saving in cost and with the effect of enabling all the inmates to keep warm all day and night. In fact, in the middle of a Russian Winter people wear only thin undervests and sleep at night with a single blanket; while we shiver and shake before smoky fires and dress in thick semi-arctic clothing, besides having the privilege of wasting a large part of our income on coal. To be brief, Swedes, Germans, Russians and Canadians laugh at our arrangements. The writer has inquired whether colds are very frequent in Northern Europe and has generally been told that such is not the case, but that colds begin only in the Spring when the windows are first opened. As an experiment he once spent five days in Stockholm in December with windows closed (and remained perfectly well), but one comparatively warm night opened the window and heaped blankets on his bed as in England. The next evening a bad cold commenced.

Englishmen complain that rooms in Northern Europe are stuffy, but this may possibly be a mere auto-suggestion. Personally, the writer prefers the Continental system—one is warm all the time in the house, and when one goes out one can brave the outside cold in a thick coat without having been previously thoroughly chilled in the house.—*Science Progress.*

AIR DISTRIBUTION IN ACTIVATED SLUDGE TANKS

Mr. A. W. Haddow, acting city engineer of Edmonton, Canada, gives an interesting account of the compressed air distribution devices employed in the activated sludge tanks of the sewage disposal system.

The air main, he says, along the center of the tanks has been started off at 10 in. diameter. This 10-in. main is of cast iron, as it is found to be best for tapping and making tight connections for the down pipes. The tank under experiment has four 1½ in. down pipes, with a valve, and a Dart union below the valve on each pipe. They are placed 30 in. on centers and branch into two 1-in. pipes at the bottom of the tank running toward each end, where they are plugged. Each down pipe with its two branches is an independent unit, and by unscrewing the union it can be lifted for examination without interfering with the blowing on the three other pipes. The two branches are supported from channel irons by means of six ⅜-in. hollow rods (pipe), which by means of a thread and nut give a slow-motion control of the air pipes. After the air pipes have been set dead level, it is necessary both to raise and to lower them by

means of these nuts to obtain perfect air distribution.

THE AIR PIPE PERFORATIONS

The air pipes have ⅛-in. holes drilled *on the under side* at 3-in. centers. This gives better distribution than drilling on the top or on the sides. So far, Mr. Haddow reports, the resulting air distribution is excellent. Each down pipe is connected, below the valve and above the union, to a branch from a 3-in. high-pressure water main (100 lb. per square inch) for flushing purposes. These four water branches are controlled by a single valve. In addition, the water can be shut off by a main valve and steam admitted through the same piping. Provision is made for expansion on this account. Then, as already stated, each air line can be lifted independently and cleaned, if the water and steam are not sufficient. A check valve is introduced on the main air feed, near the blower, to prevent water getting into the blower in case of carelessness in operating the valves.

ROCKS WHICH TELL THEIR OWN HISTORY

The walls of the Grand Canyon in Arizona form a great natural geologic section, in which each layer of rocks is in its original position relative to those above and below it. In few other places, however, is the story of the upbuilding of the earth's crust so plainly and impressively told. As a rule, the geologist who would decipher the records of the rocks must get a bit here and a bit there. He may find the edges of some beds exposed in a river bluff and others sticking out on a steep mountain side. He determines by fossils or other means the order in which the beds were deposited, and by putting all his information together he constructs what he calls a columnar section for the district in which he is working —that is, a section showing the order, thickness, and character of the beds. Such a section discloses the strata that form the upper part of the earth's crust at that place, just as a slice of layer cake shows at a glance the various layers of which it is composed.

After a number of districts in a region have been studied and their general columnar sections determined, the geologic history of the region can be learned by comparing these sections, just as the engineer who is drilling for low-grade copper ores compares his drill records and thus learns the outlines of the ore body. Such a comparison of the beds at one place and another shows how certain beds change in character and thickness from place to place or even thin out and disappear. It enables the geologist to draw some conclusions as to the former distribution of land and sea, to distinguish the deposits laid down in deep water from those spread by rivers over their flood plains, and to reconstruct in imagination the course of events at a time long before the beginning of the Grand Canyon. Such a comparison has recently been made for Arizona and is published by the United States Geological Survey, Department of the Interior, as Professional Paper 98-K, by F. L. Ransome, geologist. The report is obtainable on request from the Director.

Two Argentines, Señor Bradley and Lieut. Zuloaga, recently succeeded in crossing the Andes, starting out in a balloon from Santiago, Chile, and landing some four hours later near Mendoza, on the Argentine side. The report states that the aeronauts experienced contrary winds and ascended to a great height. This is the first crossing of the Andes by aeronauts.

SOMETIMES

Sometimes I long for a lazy isle,
  Ten thousand miles from home,
Where the warm sun shines and the blue skies smile
  And the milk-white breakers foam—
A coral island, bravely set
  In the midst of the Southern sea,
Away from the hurry and noise and fret
  Forever surrounding me!

For I tire of labor and care and fight,
  And I weary of plan and scheme,
And ever and ever my thoughts take flight
  To the island of my dream;
And I fancy drowsing the whole day long
  In a hammock that gently swings—
Away from the clamorous toiling throng,
  Away from the swirl of things!

And yet I know in a little while,
  When the first glad hours were spent,
I'd sicken and tire of my lazy isle
  And cease to be content!
I'd hear the call of the world's great game—
  The battle with gold and men—
And I'd sail once more, with a heart aflame
  Back to the game again!—*Berton Braley.*

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

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THE PNEUMATIC MAIL TUBES

Compressed Air Magazine in a way stands for "Everything Pneumatic," yet it never advocates anything pneumatic simply because it is pneumatic, but only because while it is pneumatic it still has in each specific case practical reasons for its employment. We have no retainer for the defense of pneumatic postal tubes, but when their status is questioned and they are in danger of being unjustly dealt with it is our duty to have our say.

Pneumatic tubes were welcomed in the postal service of our larger cities as savers of labor and quickeners of distribution; they have a record of years of satisfactory service and had come to be regarded as an indispensable feature of modern postal efficiency. Nevertheless in the Post Office Apropriation bill now before Congress it is proposed to eliminate the use of pneumatic mail tubes in all our cities with the exception of a part of the service in New York.

It is reported that this proposition has been approved by the committee of the House of Representatives in charge of the bill by a vote of 9 to 6. It may be worth while to note that nine congressmen who would throw out the pneumatic tubes come from the following states: Tennessee, Indiana, Texas, Alabama, Kentucky, Kansas, California, North Carolina, Virginia, neither one of the number representing a constituency in touch with or having any interest in the pneumatic service.

The objection to the pneumatic tubes, so far as there may be any apparently valid objection, appears to be that while the post office business has been continuously and rapidly growing the pneumatic tubes have not grown. They, for instance, as they are at present, are of little or no use for parcel post service, which was not put in existence until years after they were installed.

While it remains the fact that the tubes will transmit first-class mail matter between local stations in times which must be counted by seconds of time, while minutes, with possible delays at all times, must be allowed for any means of street transmission, two possible common sense solutions of the problem might be suggested. The first would be to increase the capacity of the pneumatic transmission to meet the increased business thrown upon it, and the second way would be to still use the pneumatic

tubes to the limit of their capacity and to supplement this by street transmission to whatever extent might be necessary.

Instead of this the proposition is for the Post Office Department to throw out the pneumatic tubes entirely, and to become the purchaser of great numbers of motor trucks. How great the numbers of such motor trucks might be, and how great a business interest is thus arrayed against the tubes, is suggested by the fact that some two hundred motor trucks are now employed in the mail service in Chicago, which number would have to be increased indefinitely with the abandonment of the tube service. Mr. Morgan, the most efficient Postmaster of New York, has estimated that it would be necessary to purchase three times as many motor trucks as there are now in New York if the tube service is curtailed as is contemplated, and that even with this increase the dispatch of the mails would be impaired, while the trucks would greatly complicate the general congestion of street traffic.

NEW BOOK

The Elements of Refrigeration. A Text Book for Students, Engineers and Warehousemen. By Arthur M. Greene, Jr., New York, John Wiley & Sons, Inc., 472 pages, 6 by 9 in. nearly 200 cuts, numerous tables and tabulated data. $4.00 net.

There are here brought together in orderly arrangement the data for designing, constructing and operating refrigerating apparatus with theoretical discussions of the principles involved. A detailed description of the application of refrigerating machinery to cold storage and ice making is followed by that of other applications which are numerous and diverse, as for instance, candy, breweries, blast furnaces, auditoriums, rinks, shaft sinking, chemical works, dairies, liquid air, etc., with related collateral information. There are numerous problems illustrating the computations to be made in refrigerating work. The book is copiously indexed.

The author refers to the various sources from which his information was assembled and handsomely thanks his wife for aid given in the preparation of the manuscript and in the reading of proof.

"HOW THE WINDOWS WERE BROKEN"

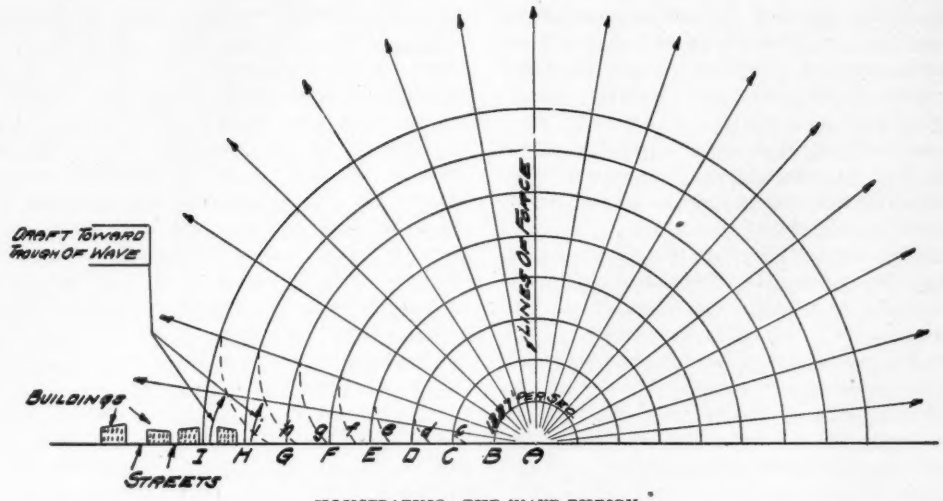
BY T. R. HAYTON.

The article with the above title by Mr. Frank Richards in the December issue of Compressed Air Magazine was on the whole quite interesting, and especially so to me, as I have for some time been making a specialty of handling water and air, but when it came to explaining the real cause of the glass breaking outward I did not see it in the same light. It is not my intention to give a strictly scientific explanation, and exact figures could hardly be made from a theoretical view point only.

Referring to the diagram, let A be the center or seat of the explosion and B, C, D, etc., distances out from A in all directions, covering a hemisphere or semi-globe, the arrows indicating the force as it radiates in all directions. The assumption is that the force would be theoretically equal at equal distances from the centre of the explosion. While this is no doubt true theoretically it will not be so practically, and for that reason I show dotted lines c-d-e-f-g-h-i which leave the theoretical lines at a distance above the ground and reach the ground at a distance much closer to the seat of the explosion. These lines represent the force in the shape of a wave as it radiates from the center, this to be described later on.

In a great explosion of this kind the earth is practically unyielding, while the atmosphere offers comparatively little resistance to the power turned loose. The earth being unyielding, the atmosphere gets the entire force expended, with the result that the adjacent air is literally blown out of that immediate locality and given a tremendous velocity outward in all directions. As it travels outward against the surrounding atmosphere it compresses it to a greater density. This air quickly gets into motion and a gigantic wave is launched outward in all directions. The entire force of the explosion is converted into kinetic energy or energy of motion.

As it travels outward and upward against the surrounding air the area or volume occupied rapidly increases and the speed decreases till it reaches a velocity of 1337 feet per second, which represents the velocity head equal to the pressure of one atmosphere. We may call this point B in the sketch. This is where the perfect vacuum or nearly perfect vacuum, as the case may be, ends. At this point we



ILLUSTRATING THE WAVE THEORY.

will have, say about two atmospheres of pressure at the crest of the wave and but little pressure in the trough of the wave which always follows the crest. Now as this wave travels out and up in all directions, its area increases and the pressure at the crest decreases proportionately. The partial vacuum following the crest changes for the same reason and in direct proportion to the crest. Its speed outward is practically uniform at all points except near the earth where it loses speed by contact with the buildings, trees and other obstructions. It is evident that the retarding of the part of the wave near the earth brings it in close proximity to the trough or partial vacuum which follows the crest and eventually causes it to be absorbed by the partial vacuum. In this way the pressure effect that always precedes a wave does not reach the earth after it has traveled a certain distance. The air being light it responds very quickly to a variation in pressure. It is also evident that eighty to ninety per cent. of the energy represented in the waves radiating from the seat of the explosion, is unaffected by friction at the surface. For that reason the trough of the wave can absorb the small part of the crest near the earth without being changed in pressure to speak of.

The nature of an air wave makes it rather difficult to explain, in that we can not see an air wave and, unless we had pressure instruments to register the pressure, we can not say definitely how much these variations will be. The force however must act in straight lines from the center out and up in all directions, and while the force causing the wave travels outward only from one particle to another, the air itself goes out for a distance and back and out again in a sort of vibrating motion. An air wave represents a layer of air that is under greater pressure than normal and followed by another layer that is under less pressure than normal. The size of the wave must depend on the force producing it. If the force is great enough to throw the air out to a distance of 300 to 400 feet from the center, it will practically double the pressure at that point and the momentum will carry it far enough to produce a partial vacuum nearly equal to the extra pressure of the crest.

The larger the explosion causing the wave the greater the distance between the crest of the initial wave and the crest of the secondary wave. It would seem that this distance should be a little more than double the distance from the center to the point where the speed amounts to 1337 feet per second. It is a well known fact that a wave in water runs according to the depth of the water and the force causing it. The greater the force the greater the distance from crest to crest.

It is also well known that a water wave does not require a large amount of power to keep it running. In fact it is remarkable how little power will keep it going. It sometimes takes hours for the waves to die down after the wind stops, especially is this true in large,

deep bodies of water. It may be possible that an air wave will die out quicker than a water wave on account of the air being so light and rarified. Be that as it may, the fact remains that in some way the glass in the windows is broken, and the evidence points clearly to the fact that the pressure is lower outside than inside and that the expansion of the air inside breaks the glass.

It also seems clear that the wave solution offers the only logical theory that can be advanced for connecting the force of the explosion to the breaking of the windows. The theory of the friction causing the absorption of the pressure part of the wave near the earth and leaving the vacuum effect as the only effect felt in such cases, seems to be the only way of explaining this result. If we notice the telescoping effect of the smoke issuing from the exhaust of a locomotive and remember that the surrounding air causing the resistance is free to move, it will readily be seen that the resistance offered by obstructions that are stationary can easily cause the effect described.

This wave theory, however, is not the first one that came into the writers mind. The first theory was as follows: It is barely possible that this theory works in combination with the wave theory to bring about the vacuum responsible for the breaking of the windows. This theory is based on the well known law that it requires the same force to stop a body in motion that it takes to produce the motion in the first place. On this basis if we take for granted that the explosion turns loose for the instant a hundred million horse power, and that this energy acts in all directions out and up, starting the air off at a tremendous speed, and when we remember that nearly the whole of this force goes up into the space above, and that it continues to set the air in motion till this hundred million horse power is literally used up or consumed in losses, we must know that a partial vacuum is caused by the rush outward, and that there will be a rush back to fill the space caused by this great out-rush from the center. Then when we take into consideration the fact that no motion can occur in a fluid such as air or water without a difference in pressure, we can readily see that a partial vacuum will be formed in the vicinity of the explosion and that this vacuum will reach out as far as the force produces a perceptible motion in the air.

This briefly described theory was the first that I had on this cause. But I am now thoroughly convinced that the wave theory, while it may work together with this theory, is the one that is the more logical, and without a doubt is the true solution of the question at issue. We cannot expend any amount of energy in water without causing a wave. One drop of water falling in a body of water causes a wave to flow out, and this wave will run until it uses up the energy whether it be large or small, the greater the energy expended the greater the wave. We must recognize very nearly the same effect in air. The difference being mainly in its elastic nature. In this way the great force of the explosion at any point causes a rush of air out against the surrounding air, setting it in motion and it sets more in motion and so the wave runs until its force is expended and scattered over such an area as to become imperceptible.

Appleton, Wis.

HOW THE WINDOWS WERE BROKEN

Editor of Compressed Air Magazine:

Dear Sir:

The article in your October magazine by Mr. Frank Richards, on "How the Windows Were Broken," was very interesting and instructive, but I think he has missed one point that may have very largely entered into the breaking of the glass, and that is the effect of the "recoil." As is well known, every explosion is followed by what is technically known as the recoil. The effect of an explosion is, firstly, to consume a certain amount of the atmosphere at the immediate seat of the explosion, and, secondly, to compress and force back, by the tremendous expansion of the gases produced by the explosion, the atmosphere immediately surrounding the zone of explosion. This produces "the great surge of air over a large area" noted by the author.

This movement of the air away from the explosion naturally creates a partial vacuum at that point. It must therefore be, and is, followed by an equal reflex action of the atmosphere towards the place of explosion, in order to restore the equilibrium and pressure of the air at that point. Therefore, in the absence of exact time and pressure records within and without the buildings, proving irregularity of local pressures, and without re-

liable and exact testimony of witnesses at various points, which might have established the theory of Mr. Richards, that the phenomena were caused by sheltering or retarding buildings causing local vacuums, I am inclined to attribute the "vacuum" entirely to the recoil effect of the explosion.

If witnesses can be found, who noted positively that the windows fell outward coincidently with the first surge of the air away from the explosion, then Mr. Richards' contention could be established, but if there was an appreciable pause before the windows fell outward, and especially, if the observer was cool enough, and wise enough to notice the recoil, and the coincidence of the falling glass, then my point, that the phenomena were caused by the reflex action will be proven.

My own experience with explosions would lead me to believe that the observers were too closely engaged in running for shelter to have noticed with such exactness, and that it is unfair to add this new peril to the many imaginary ones already attributed to skyscrapers.

S. H. BROCKUNIER.

Nevada, City, Calif.

THE FIRST LOCOMOTIVE WHISTLE

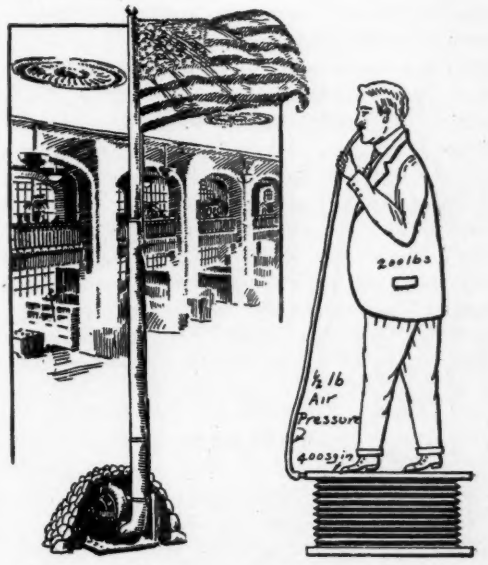
On May 4, 1833, there occurred an accident that gave us the locomotive whistle. It was on a level crossing between Bagworth and Thornton in England. Stephenson's locomotive "Samson" ran into a market cart containing 50 pounds of butter and 80 dozen eggs. A meeting of the directors was called, and Stephenson's suggestion of a whistle blown by steam was adopted. He went at once to a musical instrument maker in Leicester, who constructed a steam trumpet, which ten days later was tried in the presence of the board of directors. In appearance it was like a huntsman's horn, 18 ins. long and 6 ins. across at the top. It may be remembered that Rev. Sydney Smith, who flourished in those days, said that the whistle made him think of the squeal of a lawyer when the Devil first gets hold of him.

GASOLINE AND AIR

At ordinary temperatures, air will hold about 5 to 28 per cent. of gasoline vapor. As gasoline vapor is about 3 times as heavy as air, in a room containing a mixture of the vapor with air, the vapor is found in largest proportion near the floor.

The limits of explosibility of mixtures of gasoline vapor and air are between about 1.4 and 6 per cent. of gasoline vapor, although dangerous flashes may be produced with mixtures containing less and more than these proportions. In other words, there is needed only a small proportion of gasoline vapor to render air explosive—1.4 cu. ft. of vapor to 97.5 cu. ft. of air. One gallon of gasoline can under ideal conditions render 2,100 cu. ft. of air explosive.

A dangerous feature of gasoline vapor is that it may travel a considerable distance from the gasoline and there be ignited, the flash traveling back to the container of the liquid and causing a roaring fire in a few seconds.—*Bureau of Mines.*



ALWAYS A BREEZE. BLOWING HIMSELF UP.

SAVING COMPRESSED AIR

A useful little expedient was adopted in the Milwaukee water intake shore tunnel by the O'Brien & Jackson Co., contractors. The tunnel is being driven under compressed air and in addition air chisels are used in some of the headings for excavating in hardpan and hard clay. The intermittent operation of the tools is apt to produce considerable waste of power in blowoff from the receiver. To avoid this waste, a blowoff valve set at 90 lb. was placed on the high-pressure air line within the tunnel,

on the heading side of the air lock. Whenever the demand of the air chisels is low the excess high-pressure air escapes into the tunnel via this valve, and thus increases the low pressure air supply and reduces the load on the low-pressure compressors.

THE ENGLISH CHANNEL TUNNEL

Some nineteen hundred years ago when Julius Caesar tried to cross the channel, so he might get on the other side, he stood upon the mainland shore and wondered why so fair a chance had been neglected thus to dig a tunnel there. In all the years since Caesar's day through which the world has slid the average man of common sense has thought as Julius did. But Britons never thought that way, and they've been sure to balk when anybody dared to start the channel tunnel talk. Some were afraid and some were blind and all of them were slow and insular and insolent and British, don't you know, and for these nineteen hundred years that channel tunnel scheme has been to every Englishman a sort of nightmare dream. But now, Gadzooks, they're waking up; the war has showed them where they've made a nawsty, bad mistake, though not beyond repair, and some day in the by and by they'll chuck their doubts and fears and there will be a tunnel yet within a hundred years. No longer then that suffrage trip, but underneath the wave, and somewhere Julius Caesar will turn over in his grave!!!—*W. J. Lampton in N. Y. Herald.*

WHAT IS MAN?

A man weighing 150 lbs. approximately contains 3500 cu. ft. of gas, oxygen, hydrogen and nitrogen in his constitution, which at 70 cents per 1000 cu. ft. would be worth $2.45 for illuminating purposes. He also contains the necessary fats to make a 15-lb. candle, and thus, with his 3500 cu. ft. of gases, he possesses great illuminating possibilities. His system contains 22 lbs. and 10 oz. of carbon, or enough to make 780 doz. or 9360 lead pencils. There is about 50 grs. of iron in his blood and the rest of the body would supply enough to make one spike large enough to hold his weight. A healthy man contains 54 oz. of phosphorus. This deadly poison would make 800,000 matches or enough poison to kill 500 persons. This with two lbs. of lime makes the stiff bones and brains. No difference how sour a man looks he contains about 60 lumps of sugar of the ordinary cubical dimensions, and to make the seasoning complete must be added 20 spoonsful of salt. If a man was distilled into water he would make about 38 qts., or more than half his entire weight. He also contains a great deal of starch, chloride of potash, magnesium, sulphur and hydrochloric acid in his system. Break the shells of 1000 eggs into a huge pan or basin and you have the contents to make a man from his toe nails to the most delicate tissues of his brain.

NOTES

The deepest drill-hole in the world is said to be one in upper Silesia where a prospect bore-hole was cut by a diamond drill to a depth of 7,347 ft. This hole is 1.44 ft. in diameter at the surface, diminishing with depth to 0.157 ft. at the bottom.

Mining furnishes employment for all classes of men, from the most highly educated to the most ignorant. The direction of mining operations as well as much of the actual work involved, requires men of training and more or less education. Owing to the fact that mining involves every branch of engineering and nearly every science, a broad education is necessary for the men who must hold the higher positions.

Out in California a centrifugal blower, driven by an electric motor, is being used in the shelling of almonds. Formerly the nuts could be shelled by hand only with the greatest difficulty. At the present time the almonds are fed into the suction side of the fan, where they are picked up by the runner and hurled against the fan casing, following which they are blown out of the discharge pipe into a box, already shelled.

Blowing cotton from one department to another through suitable tubes is the latest employment of compressed air in manufacturing points. In one instance a California felt manufacturer makes use of compressed air for conveying damp wool from the scouring plant squeezers to another building across the street, in which are located the sun-exposed drying rooms. The method is of course clean and rapid.

In timbering the Twin Peaks tunnel at San Francisco preparatory to pouring the concrete lining, about 19,000,000 ft. b.m. of lumber is being used. A large part of this was purchased by the contractors from the exposition company. The 12x12-in. timbers used in the columns of the various palaces were found to be about the size desired, and for tunnel timbers they served as well as would the more costly lumber direct from the mill.

A number of cases are cited where the poisonous effect from the exhaust gases discharged by gasoline locomotives in mines caused illness among the workmen and finally compelled the use of the machine to be discontinued. When a motor is working perfectly, securing complete combustion, the gas discharged is almost wholly CO_2 and has very little effect on health. A gasoline engine, however, due to improper adjustment or other causes, will often discharge unburned gasoline vapor in large quantities and its exhaust may contain at times carbonic oxide, the dangerous character of which is well known.

A commission of prominent engineers made a report on Nov. 20 to the city authorities of Montreal on the water-power project which has been under construction for several years in connection with the city's water-supply. The commission finds that the final cost of the project will be at least $10,600,000, and that not over 7,000 hp. will be developed. The minimum fixed charges and operating expenses of the power plant will be $108 per hp. per annum, while the city could purchase power in the open market from some of the hydro-electric plants in the vicinity of Montreal for not more than $20 to $25 per hp. per annum.

Semi-steel, although not recognized in iron and steel nomenclature, ranks among the most valuable products of the gray iron foundry. the same cupola with regular gray iron mix- More than 100,000 pounds were produced last year to meet the demand for stronger metal and lighter sections. Semi-steel is made in tures. No extra coke, special appliances fluxes or new equipment are necessary. It is made in the same heat with other mixtures. It may be melted in the early part of a heat in the middle, or in the last part of a regular heat. It may begin with 30 to 40 per cent. steel on the bed and then follow with 20 to 25 per cent. steel. The product is 25 to 60 per cent. stronger than gray iron, thus permitting a large reduction in weight.

An American self-starter for aeroplane engines based on the employment of compressed air has recently made its appearance, says the *Scientific American.* To start an engine with this device, air contained in a tank is drawn through a control valve to a special carburettor, where it picks up petrol in a thoroughly vaporised form. Through an automatic distributor the compressed gas is fed to the engine cylinders in firing sequence. The compression is sufficiently high to cause the first piston—that on the compression stroke—to move downwards; sparking takes place, and the motor soon acquires its normal speed. Compressed air is stored in the air tank by means of a small compressor driven by the aeroplane engine.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

NOVEMBER 7.

1,203,645. VALVE-ACTUATING MECHANISM FOR FLUID-PRESSURE MOTORS. THOMAS WINTER NICHOLS, Gateshead, England.

1,203,862. PUMP, ENGINE, AND THE LIKE. JEAN ZWICKY, South Tottenham, England.

1,203,703. PULVERIZED - COAL - FEEDING APPARATUS. LA RUE B. CHEVALIER, Iola, Kans.

1,203,709-10. APPARATUS FOR CLEANING COTTON. EUSTICE E. DICKERSON, Fort Worth, Tex.

1,203,739. COTTON GINNING, CLEANING, AND BLEACHING MECHANISM. WESLEY A. J. HODO, Cleburne, Tex.

1,203,839. PLUMBER'S FURNACE. ARTHUR J. ARCHAMBAULT, Chicago, Ill.

1. In a plumber's furnace a main reservoir, an auxiliary reservoir arranged within the main reservoir, means for introducing air under pressure into one of said reservoirs, and a check valve for permitting air to flow from the latter reservoir to the other and preventing a back flow of air or liquid, said check valve including a spring tending constantly to close the same.

1,203,841. CENTRIFUGAL AIR-PUMP. PAUL A. BANCEL, New York, N. Y.

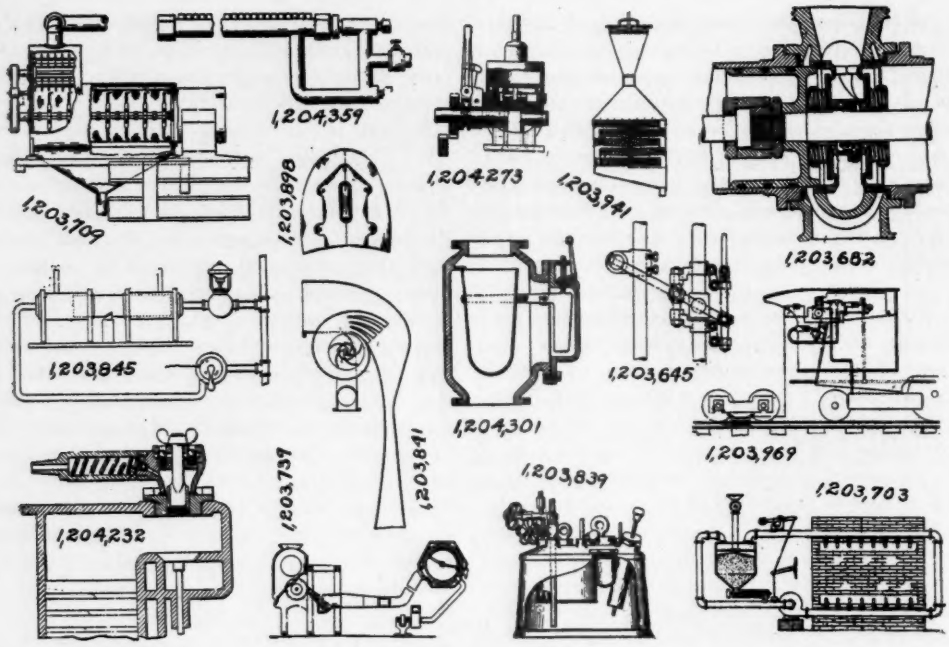
1,203,845. AUTOMATIC TRAIN-STOP. CARL H. BUHL, Cleveland, Ohio.

1,203,898. PNEUMATIC-CUSHION HEEL. OSCAR MUSSINAN, New York, N. Y.

1,203,491. PROCESS FOR DRYING AND STERILIZING AIR. REINDER PIETERS VAN CALCAR, Oegstgeest, and JAN ELLERMAN and HENDRIKUS JOHANNES MARTIJN, The Hague, Netherlands.

1,203,969. AUTOMATIC TRAIN STOP. MELBERN B. BULLA, El Paso, Tex.

1,204,273. AIR-PUMP. ROLAND C. HILTON, Boston, Mass.

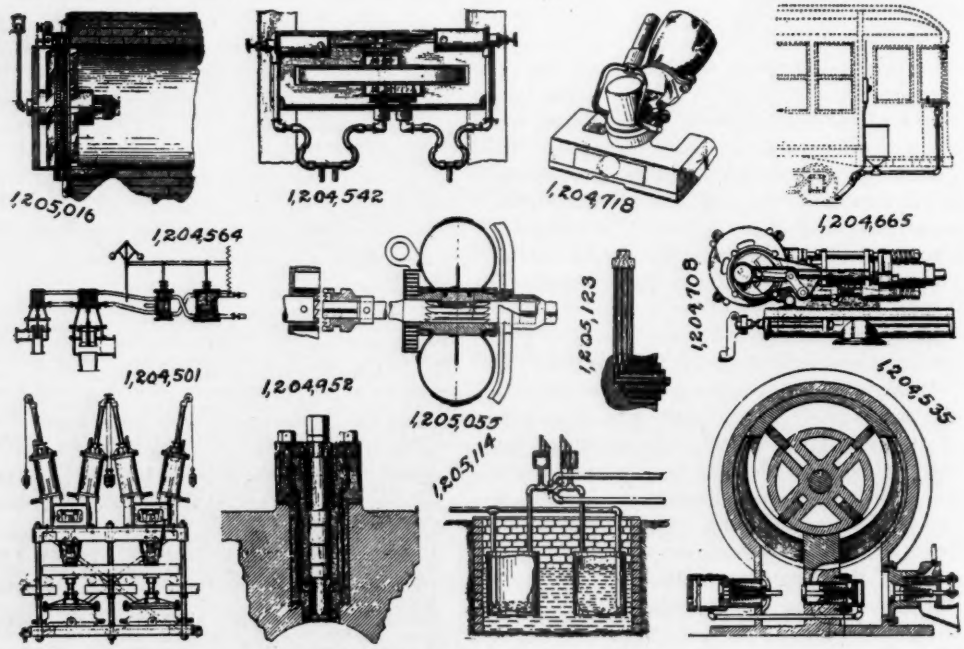


PNEUMATIC PATENTS NOVEMBER 7.

1,204,232. PNEUMATIC - TIRE - INFLATING DEVICE. ANDREW ANDERSON, West Brighton, N. Y.

1,203,301-2-3. VACUUM-BREAKER. HARRY E. MORTON, Boston, Mass.

1,204,310. PNEUMATICALLY VARIABLE TENSION-REGULATORS FOR MUSICAL INSTRUMENTS. AUGUST PHILLIPPS and OSWALD PHILIPPS, Frankfort-on-the-Main, Germany.



PNEUMATIC PATENTS NOVEMBER 14.

1,204,359. MULTIPLE BLAST-BURNER. WILLIAM W. KEMP and WILLIAM H. VAN HORN, Baltimore, Md.

NOVEMBER 14.

1,204,458. VACUUM-CONTROL VALVE FOR MILKING APPARATUS. HERMAN A. KRICKE, Crows Landing, Cal.

1,294,501. SPIKE - DRIVING MACHINE. GRANT B. SHIPLEY, Pittsburgh, Pa.

1,204,535. COMPRESSOR, PUMP, OR THE LIKE. BENJAMIN F. AUGUSTINE, Buffalo, N. Y.

1,204,542. PULSATOR FOR MILKING MACHINES. LIONELL BULL, Libertyville, Ill.

1,204,564. FLUID-PRESSURE RELAY-GOVERNOR. WILLIBALD GRUN, Frankfort-on-the-Main, Germany.

1,204,665. TRACK-SANDING DEVICE. BENJIMAN JONES and BERTRAM S. GREEN, Syracuse, N. Y.

1,205,014. PISTONLESS PUMP. JOE M. PRESSLER, Jacksonville, Tex.

1,205,016. TURBINE-BLOWER. JOSEPH ROY RAMSEY, Lykens, Pa.

1,205,055. AIR-STARTER FOR AUTOMOBILE-ENGINES. JOHN K. STEWART, Chicago, Ill.

1,205,114. COMPRESSED-AIR WATER-ELEVATOR. FRANK T. SHAW, Lordsburg, Cal.

1,205,123. SOAP-BUBBLE BLOWER. CHATTIN BRADWAY, Brooklyn, N. Y.

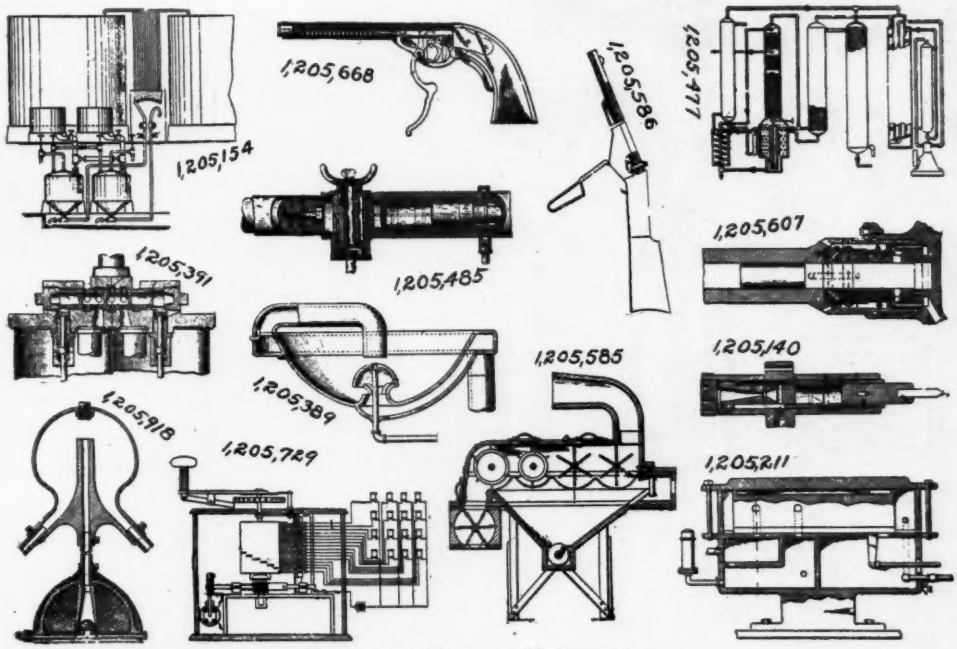
NOVEMBER 21

1,205,140. FLUID-PRESSURE - OPERATED TOOL. OLIVER O. APP, New York, N. Y.

1,205,154. WATER - PURIFYING APPARATUS. OTTO BUEDINGER, Birmingham, Ala.

1,205,162. VACUUM - CLEANER. GEORGE CLEMENTS, Chicago, Ill.

1,205,211. TRAIN - STOPPING APPARATUS. HOWARD JACKSON, Omaha, Nebr.



PNEUMATIC PATENTS NOVEMBER 21.

1,204,708. ROCK-DRILL. WILLIAM A. SMITH, Denver, Colo.

1,204,718. SUCTION CARPET - SWEEPER. JOHN R. VANDER PUTTEN, New Philadelphia, Ohio.

1,204,803. FLUID-PRESSURE GUN. PETER A. MCCULLOUGH, Pittsburgh, Pa.

1,204,831. PNEUMATIC SOUND - REGULATING MECHANISM FOR MECHANICAL PIANOS AND THE LIKE. LUIS JOVELL VILAR, Barcelona, Spain.

1,204,838. VACUUM-JAR. FREDERICK W. BARTLETT, Caldwell, N. J.

1,204,952-3-4. AIR-STARTING VALVE FOR DIESEL ENGINES. GREGORY C. DAVIDSON, New London, Conn.

1,205,000. AUTOMATIC AIR-COUPLING. ROY A. MCCURRY, Pensacola, N. C.

1,205,001. PUMP FOR PNEUMATIC CARPET-CLEANERS. JOHN J. MARKO, Detroit, Mich.

1,205,389. OIL-BURNER. WALTER G. PRESTON, Omaha, Nebr.

1. In a burner, a pan, a hot air conduit resting on said pan, the inner wall of the conduit forming a continuation of the pan, a burner cap mounted centrally with respect to the pan, means for feeding oil to said cap, and means for conducting superheated air from said conduit and discharging the same on said cap.

1,205,391. PNEUMATIC PUMP. CASPER L. REDFIELD, Chicago, Ill.

1,205,477-8. ART OR PROCESS OF SEPARATING THE GASES OF AIR. JAMES F. PLACE, Glen Ridge, N. J.

1,205,485. PNEUMATIC HAMMER - DRILL. HENRY SCHUMACHER, Denver Colo.

1,205,585. COTTON-CLEANER. SAMUEL WILLIAMS, Elk City, Okla.

1,205,586. AIR-COMPRESSION GUN. ROBERT CLIFTON WORLEY, Owens Cross Roads, Ala.

1,205,607. PNEUMATIC HAMMER. FRANK M. FABER, Canton, Ohio.

1,205,668. AIR-PISTOL. JACOB R. SANDAGE, St. Joseph, Mich.

1,205,727. PNEUMATIC PIANO - PLAYER. CHARLES FREBORG, Kankakee, Ill.

1,205,729. PRESSURE-REGULATING APPARATUS. ROBERT L. FRINK, Lancaster, Ohio.

1,205,918. TRACK - SANDING APPARATUS FOR LOCOMOTIVES. MARK R. MILLER, Charleston, and GEORGE L. DIBBLE, Florence, S. C.

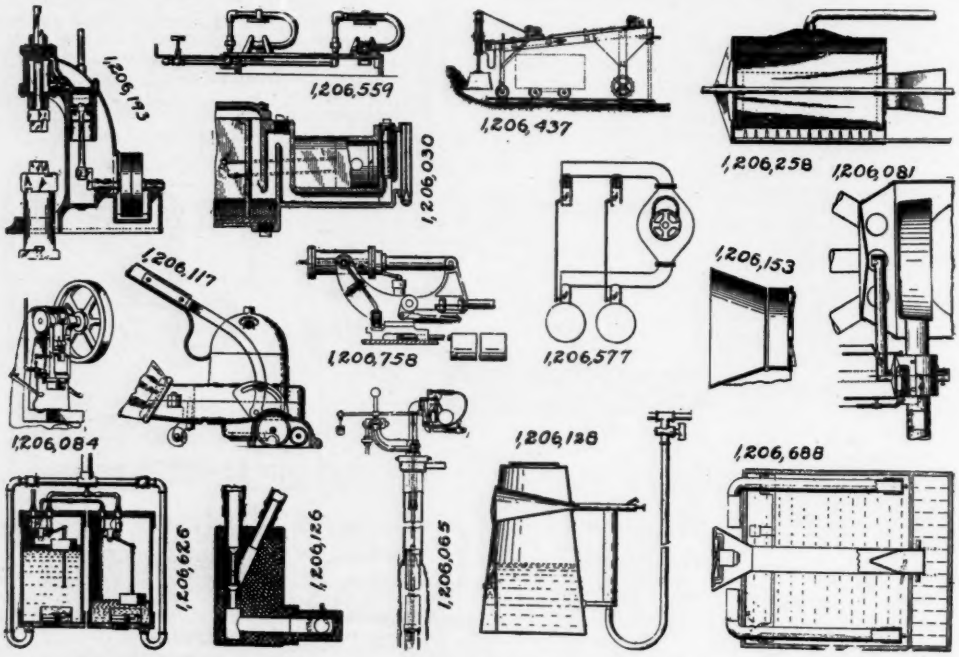
1,206,126. VACUUM-GENERATOR. JOHN A. MITSCH, Boston, Mass.

1,206,128. SPRAYING DEVICE. NEIL E. MORGAN, Hermon, N. Y.

1,206,153. AIR - DIRECTOR FOR USE IN BURNING LIQUID FUEL. HENRY PELHAM SMITH, London, England.

1,206,176. PNEUMATIC PLAYER. EUGENE T. TURNEY, New York, N. Y.

1,206,193. PNEUMATIC POWER - HAMMER. RALPH E. BATES, Philadelphia, Pa.



PNEUMATIC PATENTS NOVEMBER 28.

NOVEMBER 28.

1,206,030. FLUID-COMPRESSOR. WALTER J. RICHARDS, Milwaukee, Wis.

1,206,065. DISPLACEMENT - PUMP. ELMER A. WATTS, Springfield, and IRWIN L. DUNN, Marietta, Ohio.

1. A mechanism for elevating fluids comprising a plurality of closed receptacles arranged one above the other and spaced apart, the lowermost receptacle communicating with a source of fluid supply, a conduit leading from the lower portion of each lower receptacle to the upper portion of the next higher receptacle, and means for admitting air under pressure to the upper portion of said lowermost receptacle, whereby the air will first discharge the fluid from said lowermost receptacle through one of said conduits to said next higher receptacle and will then follow the fluid through said conduit into said next higher receptacle and discharge the fluid therefrom.

1,206,081. AIR - HUMIDIFIER. CHRISTIAN BECKER and FRANK D. KLEINHEKSEL, Holland, Mich.

1,206,086. APPARATUS FOR DELIVERING AN INTERMITTENT AIR-BLAST. REUBEN B. BENJAMIN and WILLIAM COTTRELL, Chicago, Ill.

1,206,116-7. PNEUMATIC CLEANER. JAMES B KIRBY, Cleveland, Ohio.

1,206,258. METHOD OF BLANCHING PEANUTS. FELIX SALOMON, Chicago, Ill.

2. The hereindescribed method of blanching nuts which consists in projecting membrane fracturing air jets against a mass of nuts, and moving the nuts during the application of the air jets to subject the several portions of the mass to the action of the jets.

1,206,437. TUNNELING-MACHINE. SAMUEL HOAR, Virginia, Minn.

1,206,559. HYDROCARBON-BURNER. EPPE M. LUCUS, Van Alstyne, Tex.

1,206,577. CENTRIFUGAL COMPRESSOR. SANFORD A. MOSS, Lynn, Mass.

1. In an apparatus of the character described, the combination with a centrifugal compressor having inlet and discharge conduits, of throttling valve means in each conduit for throttling the flow therethrough, and means for simultaneously operating them.

1,206,624. PNEUMATIC HORSE - COLLAR. LEMUEL E. VAN TREESE, Letts, Ind.

1,206,626. PUMP. MARION C. WALLS, Clayton, Ind.

1,206,688. VENTILATING AND AIR-PURIFYING APPARATUS. JOHN C. FLEMING, Boston, Mass.

1,206,758. TROLLEY - POLE CONTROLLER FOR ELECTRIC CARS. CLARENCE V. GREENAMYER, Los Angeles, Cal.